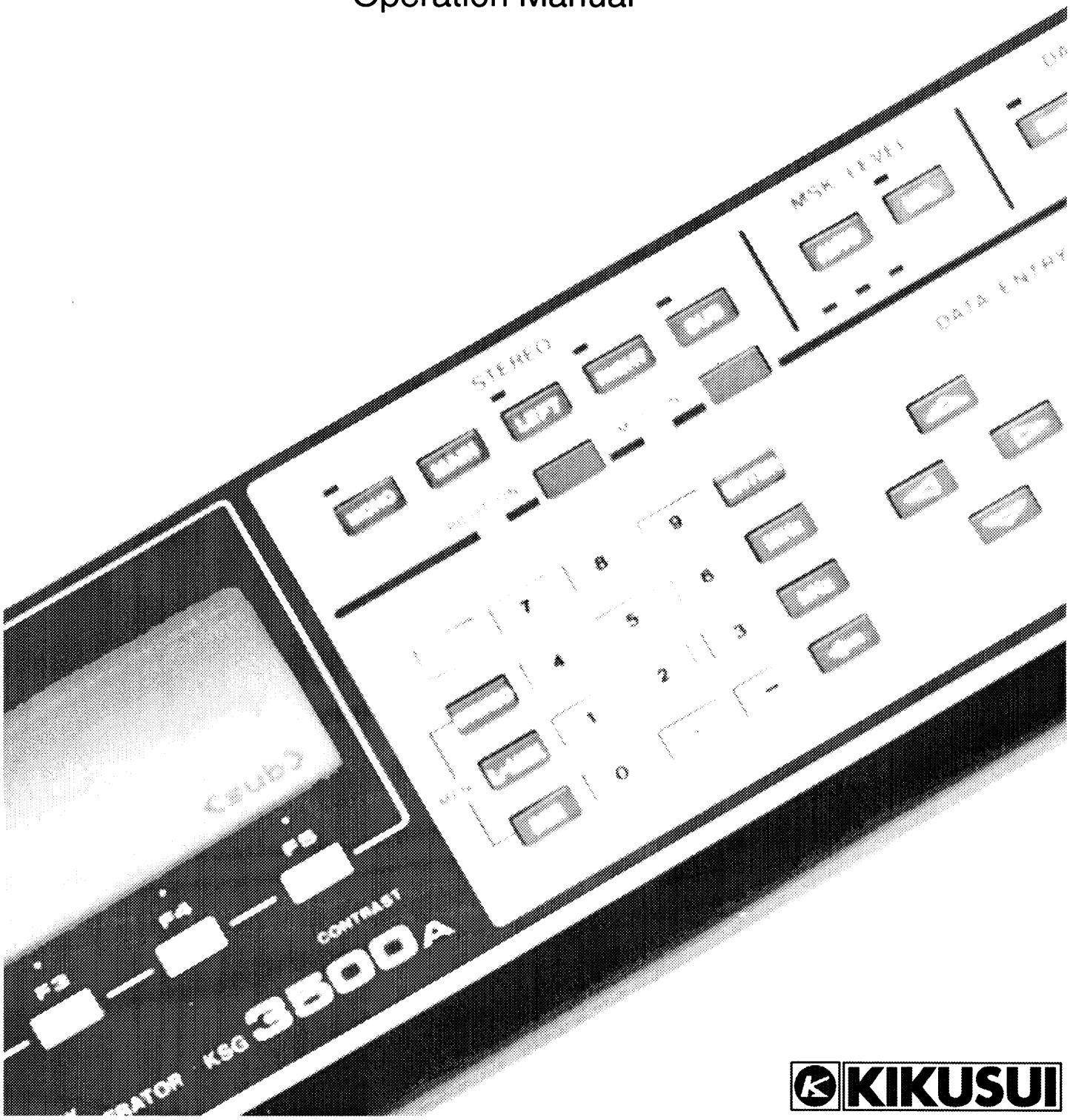
Electronic Test
Instrument &
Power Supplies

KSG Series
FM Multiple Signal Generator

KSG3500A

Operation Manual



KIKUSUI

About this manual

Please read this manual thoroughly beforehand to ensure correct operation of the product. Be sure to retain the manual so that you can use it whenever necessary. When the product is relocated, be sure the manual be included.

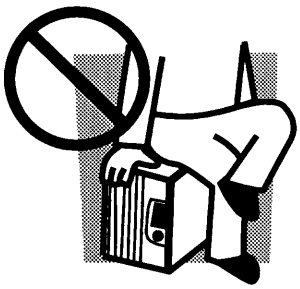
Kikusui Part No. Z1-000-882 IB000882
Printed in Japan

⚠Safety Precautions

The following safety precautions must be observed to avoid fire hazard, electrical shock, accidents, and other failures. Keep them in mind and make sure that all of them are observed properly. Kikusui assumes no liability against any damages or problems resulting from negligence of the precautions.

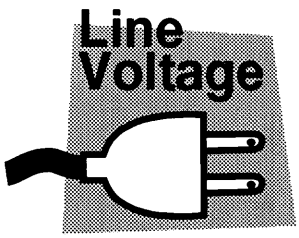
Users

- This product must be used only by qualified personnel who understand the contents of this operation manual.
- If it is handled by disqualified personnel, personal injury may result. Be sure to handle it under supervision of qualified personnel (those who have electrical knowledge.)



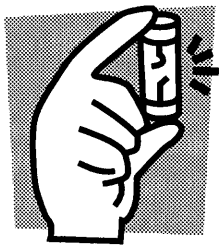
Purposes of use

- If the product is to be used for purposes not described in this manual, contact your Kikusui agent in advance.



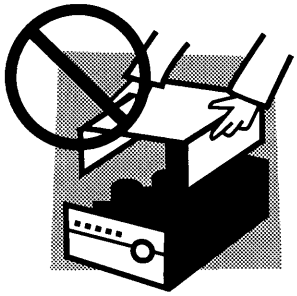
Input power

- Use the product with the specified input power voltage.
- For applying power, use the AC power cable provided. The shape of the plug differs according to the power voltage and areas. Use the cable which is suitable for the line voltage used.



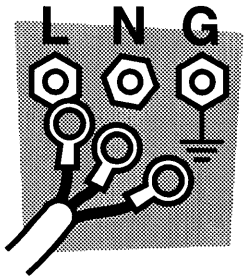
Fuse

- With products with a fuse holder on the exterior surface, the fuse can be replaced with a new one. When replacing a fuse, use the one which has appropriate shape, ratings, and specifications.



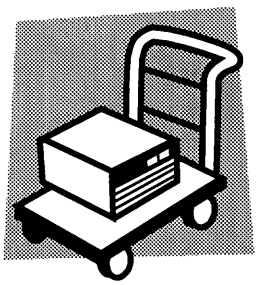
Cover

- There are parts inside the product which may cause physical hazards. Do not remove the external cover. If the cover must be removed, contact your Kikusui agent in advance.



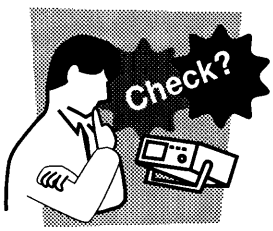
Installation

- When installing products be sure to observe "Precautions for Installation" described in this manual.
- To avoid electrical shock, connect the protective ground terminal to electrical ground (safety ground).
- When applying power to the products from a switchboard, be sure work is performed by a qualified and licensed electrician or is conducted under the direction of such a person.
- Be sure to use the AC power cable provided. Consult your Kikusui agent if other cable than included is to be used for some reason.
- When installing products with casters, be sure to lock the casters.



Relocation

- Turn off the power switch and then disconnect all cables when relocating the product.
- Use two or more persons when relocating the product which weights more than 20 kg. The weight of the products can be found on the rear panel of the product and/or in this operation manual.
- Use extra precautions such as using more people when relocating into or out of present locations including inclines or steps. Also handle carefully when relocating tall products as they can fall over easily.
- Be sure the operation manual be included when the product is relocated.

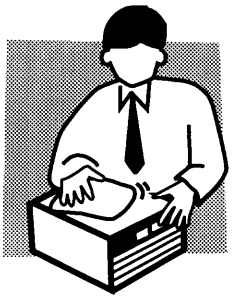


Operations

- Check that the AC input voltage setting and the fuse rating are satisfied and that there is no abnormality on the surface of the AC power cable. Be sure to unplug the AC power cable or stop applying power before checking.
- If any abnormality or failure is detected in the products, stop using it

immediately. Unplug the AC power cable or disconnect the AC power cable from the switchboard. Be careful not to allow the product to be used before it is completely repaired.

- For output wiring or load cables, use connection cables with larger current capacity.
- Do not disassemble or modify the product. If it must be modified, contact your Kikusui agent.



Maintenance and checking

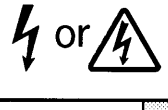
- To avoid electrical shock, be absolutely sure to unplug the AC power cable or stop applying power before performing maintenance or checking.
- Do not remove the cover when performing maintenance or checking. If the cover must be removed, contact your Kikusui agent in advance.
- To maintain performance and safe operation of the product, it is recommended that periodic maintenance, checking, cleaning, and calibration be performed.

Service

- Internal service is to be done by Kikusui service engineers. If the product must be adjusted or repaired, contact your Kikusui agent.

Safety Symbols

This operation manual and this product use the following safety symbols. Note the meaning of each of the symbols to ensure safe use of the product. (As using symbols depend on the product, all of symbols may not be used.)

	Indicates the presence of 1000V or higher. Never attempt to touch this part when the power switch of the product is turned on.
WARNING	Indicates the possibility of personal injury or death. Never fail to follow the operating procedure. Do not proceed beyond a WARNING sign until the noted conditions are fully understood and met.
CAUTION	Indicates the existence of damage to the product or connected equipment. Always follow the operating procedure. Do not proceed beyond a CAUTION sign until the indicted conditions are fully understood and met.
NOTE	Indicates additional information such as operating procedure.
Description	Describes technical terms used in this manual.
	Indicates action prohibited.
	Indicates general warning, caution, risk of danger. When this mark is indicated on the product, refer the relevant section of the Operation Manual.
	Indicates a grounding (earth) terminal.
	Indicates a chassis grounding terminal.

CONTENTS

Preface

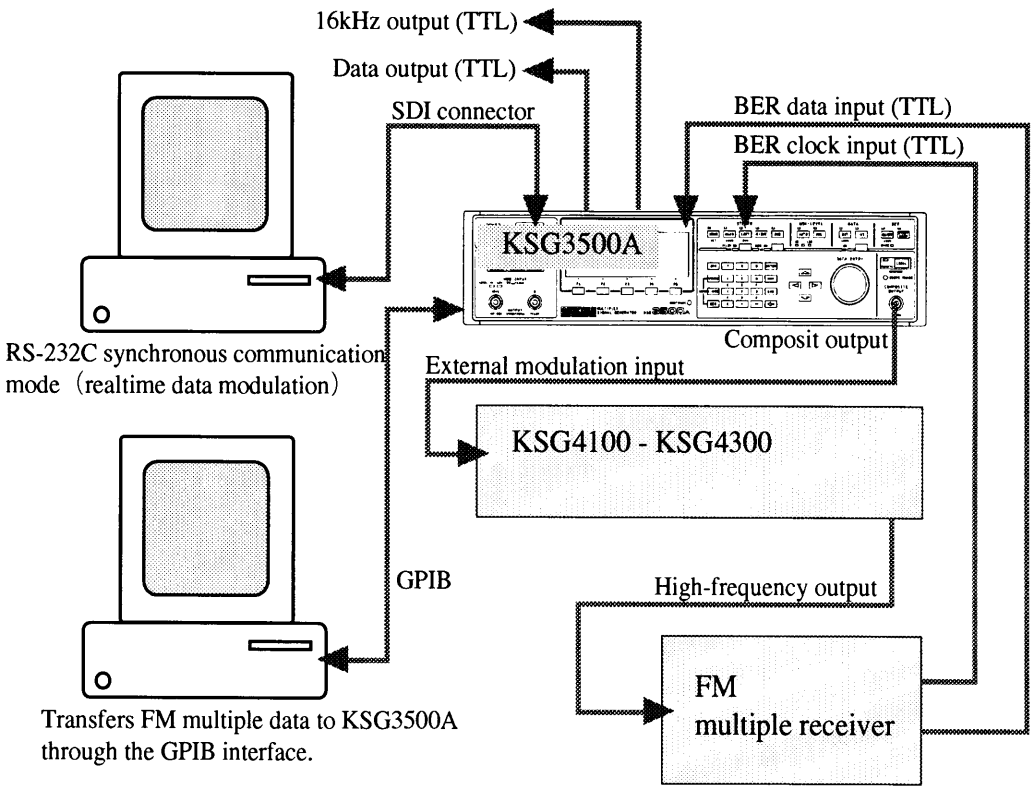
Overview

KSG3500A is an NHK-type FM multiple signal generator which generates composite signals with external input data or internal PN9 signal superposed in the Level-Controlled Minimum Shift Keying (L-MSK) method.

KSG3500A can be used as a modulator for FM multiplex broadcasting by connecting its output signal to the external modulation input terminal of

KSG4100 - KSG4300 (FM-AM standard signal generator). It can also be used to adjust, test, or measure characteristics of stereo demodulation ICs (including those of L-MSK type), FM stereo receivers with L-MSK demodulator, and tuners in the prototype research division.

In addition, this product can be used to measure the bit error rate (BER) by inputting PN9 signal demodulated by the L-MSK receiver.



FM-AM standard signal generator connection example

Features

■Stereo signal section

- Provided with internal modulation signal oscillators for seven waveforms, realizing supreme distortion of 0.01 % or less. The internal modulation oscillator signals can be output to external world, allowing the KSG3500A to be used as a spot oscillator with low distortion.

■FM multiple data and PN9 signal

- FM multiple data is input from the SDI connector DATA IN in synchronization with the 16 kHz clock (RS-232C level) output from the SDI connector (25-pin D-SUB connector) on the rear panel. In addition, data can be directly received from a personal computer in the synchronous communication mode.

- Through GPIB, FM multiple data can be stored in the KSG3500A memory and output.

- The PN9 signal generator is built in KSG3500A and PN9 signal can be superposed selectively with FM multiple data.

- KSG3500A can output data and clock from the rear panel. In addition, it can invert the data and clock polarities.

■Bit error rate (BER) measurement section

- This section measures the BER by automatically and synchronously detecting PN9 signal.

- It can invert the data the clock polarities individually.

■Operation

- Various settings and changes can be made with the numeric keypad or rotary switch and displayed on the LCD screen.

■Memory function

- All data on the panel can be stored in memory, allowing 100 points to be stored and recalled.

■External control

- Provided with GPIB and RS-232C interfaces as standard, allowing remote control on panel operations.

Chapter 1 Setup

This chapter provides basic information before actual operations such as unpacking, installation, etc.

1.1 Checking at Unpacking

When you unpack the product, make sure that you have all the parts and that none have been damaged during transportation. If any parts is damaged or missing, contact your Kikusui agent.

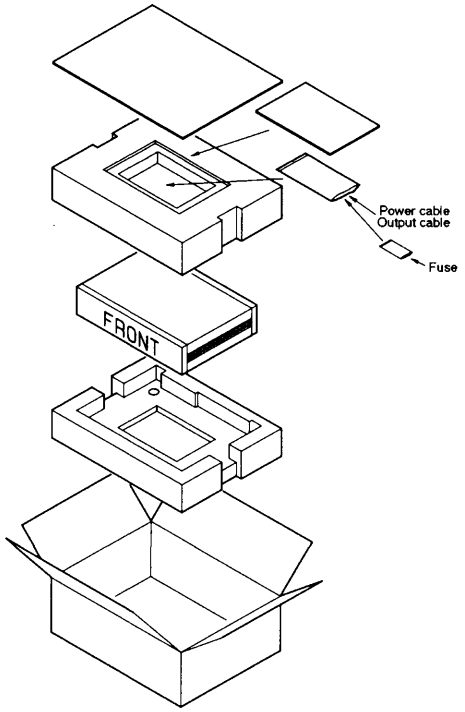


Fig.1-1 Packing/Unpacking the Parts

Accessories	Quantity	Check
Power cable	1	
Output cable (SA570)	1	
100V fuse, 1.0A	1	
200Vfuse, 0.5A	1	
Operation Manual	1	

CAUTION

- When transporting the product, be sure to use the original packing materials. If they are missing, contact your Kikusui agent.
- When packing the product, remove the power cable and all other connection cables.

1.2 Precautions for installation

Be sure to observe the following precautions when installing the unit.

■ Do not use the unit in a flammable atmosphere.

To prevent explosion or fire, do not use the unit near alcohol or thinner, or in an atmosphere containing such vapors.

■ Avoid locations where the unit is exposed to high temperature or direct sunshine.

Do not locate the unit near a heater or in areas subject to drastic temperature changes.

Operating temperature range : 5 to 35℃

Maximum allowable temperature range : 0 to 40℃

■ Avoid locations of high humidity.

Do not locate the unit in high-humidity locations, i.e., near a boiler, humidifier, water supply, etc.

Operating humidity range : ≦ 85%RH

Maximum allowable humidity range: ≦ 90%RH

■ Do not place the unit in a corrosive atmosphere.

Do not install the unit in a corrosive atmosphere or one containing sulfuric acid mist, etc. This may cause corrosion of various conductors and imperfect contact with connectors, malfunction and failure, or in the worst case, a fire.

■ Do not locate the unit in a dusty location.

■ Do not use the unit where ventilation is poor.

Leave an open space around the unit to obtain flow.

■ Do not install the unit along a tilted section of floor or in a location subject to vibrations.

■ Do not use the unit in locations affected by strong magnetic and/or electric fields.

1.3 Checking the Input Fuse

When replacing a fuse with a new one, use a fuse conforming to the input current ratings. (See the LINE VOLTAGE table on the rear panel.)

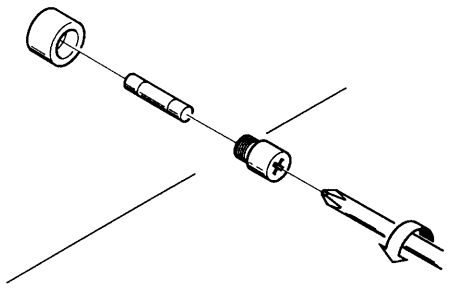


Fig.1-2 Checking the Input Fuse

1.4 Checking the AC Input Power

Make sure that the VOLTAGE SELECTOR is set to the power voltage to be used. (See the LINE VOLTAGE table on the rear panel.)

If it is not, once pull out the selector and then insert it again with the arrow mark aligned with the mark of the power voltage to be used (indicated by A, B, C, or D).

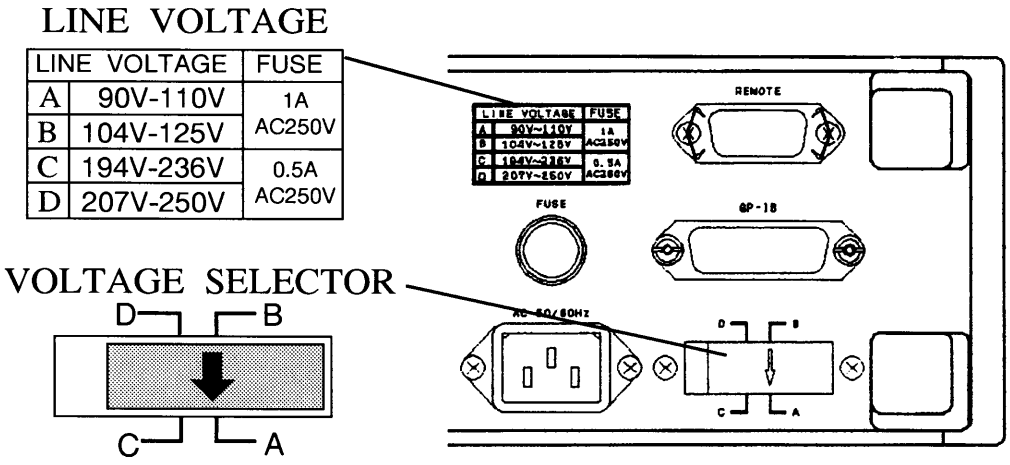


Fig.1-3 Checking the Power Requirements (Rear Panel)

Chapter 2 Operations

This chapter describes powering on, basic operations, and setting procedures.

2.1 Turning the Power On

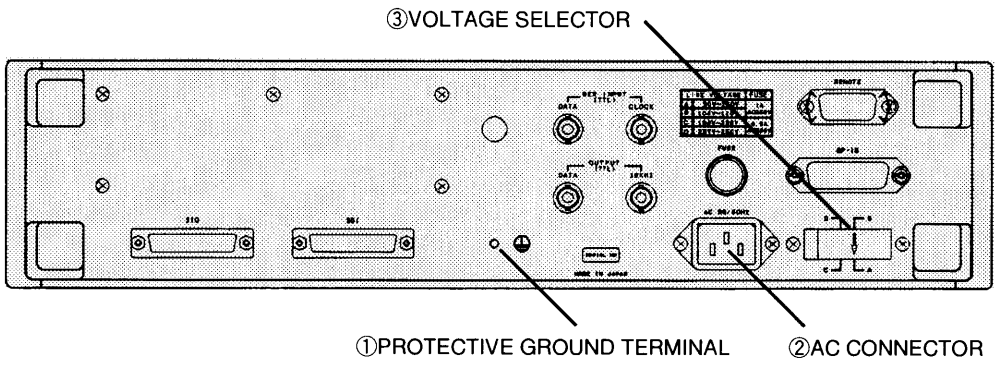


Fig.2-1 Rear Panel

① Make sure that the 【POWER】 switch is turned off.

② Connect the protective ground terminal to a good ground.

③ Make sure that VOLTAGE SELECTOR on the rear panel is set to the power voltage to be used. (If the setting is wrong, make correct setting.)

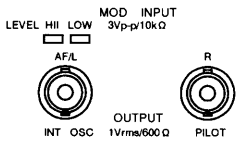
④ Connect the power cable to the AC connector on the rear panel.

⑤ Plug the power cable into the correct power line.

CAUTION

- If VOLTAGE SELECTOR setting is wrong, the fuse may be damaged.

⑥ Make sure that nothing is connected to the AF/L and R connectors on the front panel. (Connection will be made upon completion of panel setting.)

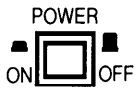


CAUTION

- Each of the AF/L and R connectors is in the output or input mode depending on the panel settings. If the panel settings do not agree with the usage, signals may be in conflict with each other and the KSG3500A be damaged.

⑦ Turn on the 【POWER】 switch.

All indicators on the front panel once go on. Then the KSG3500A is put in the condition existed before the power is turned off, except the [LEVEL HI/LO] indicator.

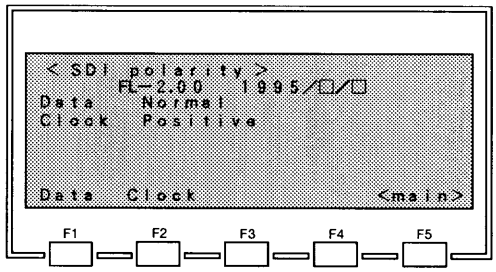


2.2 Checking the ROM Version

This operation manual applies to Version 2.0*.

The ROM version number is displayed in the second line when the 【2nd】 and 【-】 keys are pressed successively in this order.

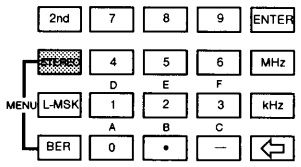
Display example



2.3 Basic Operations

The LCD indicator screen has three modes selected by 【STEREO】, 【L-MSK】, and 【BER】 keys of the menu.

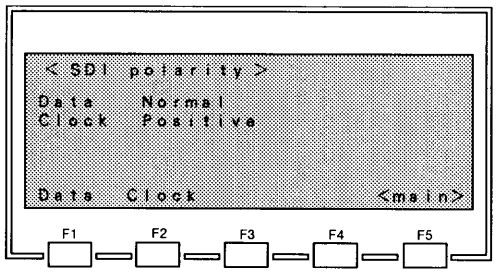
Each of the <STEREO>, <L-MSK>, and <BER> screens can be displayed from the other screens.



2.3.1 Common Items for the LCD Screen

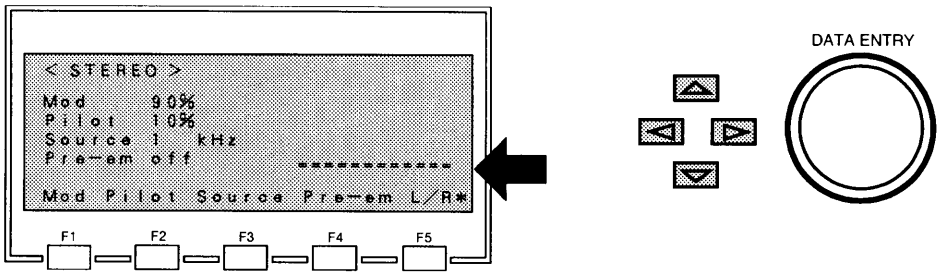
- The "<" and ">" marks in the selection menu above the function keys (F1 to F5) indicates that screen switching is to be performed when the function is selected.

  With functions without the "<" and ">" marks, cursor movement to the corresponding setting item or on/off switching is performed.



  Cursor movement to setting items can also be performed with the 【△】, 【▽】, 【▷】, and 【◁】 keys.

- When the 【2nd】 key is pressed, the "✱" mark appears at the lower right corner of the screen, entering the execution mode of the functions displayed in yellow or the second function operation mode. When the 【2nd】 key is pressed again, these modes are canceled.

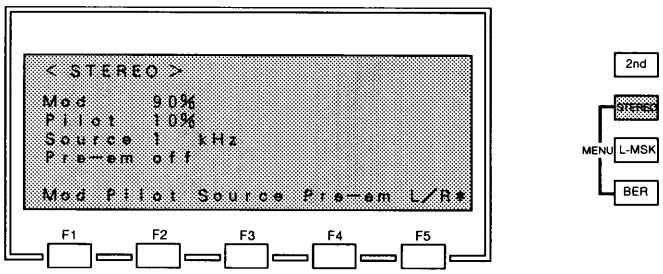


· The screen display may be disturbed by, for instance, rotating the rotary knob rapidly. In such a case, press the 【⇦】 key to update the screen.

2.3.2 Setting STEREO Mode

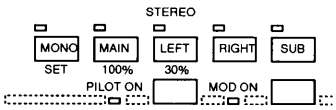
The <STEREO> screen is displayed when the 【STEREO】 key is pressed from the menu.

■Setting <STEREO> screen



■ Changing modulation mode

Change the modulation mode by pressing the 【MONO】, 【MAIN】, 【LEFT】, 【RIGHT】, or 【SUB】 key of STEREO.



NOTE

· When MONO is selected, the 【PILOT ON】 key cannot be set ON.

■ MOD ON key

Modulation can be set ON/OFF by pressing this key. It is on when the indicator LED is lit.

■ Setting Mod modulation level

Description

· "Level" in this manual refers to the percentage of the output on the L-MSK screen to the set value.

The percentage can be set in the range of 0 to 100% in steps of 0.5%.

① If the cursor is not at [Mod], move it there by using the Mod (【F1】) key or the 【△】 , 【▽】 , 【▷】 , and 【◁】 keys.

② Use the rotary knob or numeric keypad to set the modulation level.

Rotary knob: Used to increase or decrease the value at the cursor position.

Numeric keypad: Used to directly set the percentage by inputting the value. For example, input 【8】 【0】 【ENTER】 to set 80%.

■ PILOT ON key

The pilot signal can be set on/off by pressing this key. The signal is on when the indicator LED is lit.

■ Setting Pilot signal level

The percentage can be set in the range of 0 to 15% in steps of 1%.

① If the cursor is not at [Pilot], move it there by using the Pilot (【F2】) key or the 【△】 , 【▽】 , 【▷】 , and 【◁】 keys.

② Use the rotary knob or numeric keypad to set the pilot level.

Rotary knob: Used to increase or decrease the value at the cursor position.

Numeric keypad: Used to directly set the percentage by inputting the value. For example, input 【1】 【0】 【ENTER】 to set 10%.

■ Selecting Source modulation signal

① If the cursor is not at [Source], move it there by using the Source (【F3】) key or the 【△】 , 【▽】 , 【▷】 , and 【◁】 keys.

CAUTION

· When an input signal is connected to the AF/L or R connector, carefully select the modulation signal. The AF/L and R connectors may be in the input or output mode. For certain set conditions, signals might collide and damage KSG3500A.

Mode	AF/L connector	R connector
EXT	Input	Output
EXT L/R	Input	Input
Others	Output	Output

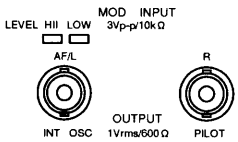


Table 2-1 Modes and input/output states

②Use the rotary knob to select the modulation signal.

As a modulation signal, select one internal signal, one external signal, or two external signals.

· When selecting an internal modulation signal, it should be one of the following:

30 Hz, 100 Hz, 400 Hz, 1 kHz, 6.3 kHz, 10 kHz, 15 kHz

· When selecting one external modulation signal, proceed as follows:

Set the rotary knob to [EXT].

Input the correct level (approximately 3 V p-p) to the AF/L connector.

Adjust the external signal source input level so that both the [LEVEL HI] and [LO] lamps are off.

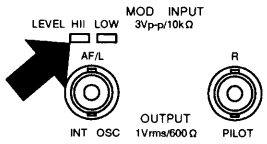
· When selecting two external modulation signals, proceed as follows:

Press the L/R (【F5】) key and select [EXT L/R].

The [LEFT] and [RIGHT] indicator lamps go on simultaneously. The AF/L connector becomes the L (left-side) stereo signal input terminal and the R connector becomes the R (right-side) stereo signal input terminal.

Adjust the L level so that both the [LEVEL HI] and [LO] indicator lamps are off.

For adjustment of the R level, switch over to the AF/L connector, adjust the R level so that both the [LEVEL HI] and [LO] indicator lamps are off, and then reconnect the R connector.



Description

- If the external signal source input level is adjusted so that both the [LEVEL HI] and [LO] indicator lamps are off, the setting error will be within ±2%.

  The modulation level is internally set to a digital value based on the set value, so it is not necessary to readjust the external signal source input level when the modulation level or modulation mode is changed.

  The relationships between the input and modulation levels are linear (see Figure 2-2).

  The modulation level of 50% is obtained by adjusting the external signal source input level so that both the [LEVEL HI] and [LO] indicator lamps are off, setting the monaural/ stereo modulation level to 100%, and then attenuating the input level by 6 dB.

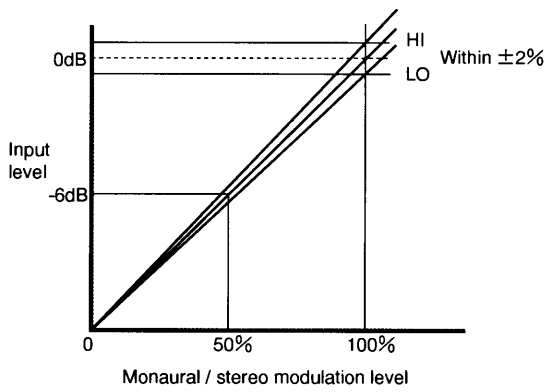


Fig. 2-2 Input level

NOTE

- When the input level is attenuated by 6 dB, the modulation level of 50% is obtained, but the <Stereo> Mod indication remains 100%.
- After adjusting the external signal source input level so that both the [LEVEL HI] and [LO] indicator lamps are off, the [LEVEL HI] and [LO] lamps may go on alternately when changing over between MAIN, LEFT, RIGHT, and SUB.

Description

- As for the peak level of the composite signal output (MAIN signal + SUB signal + PILOT signal), two periods of 38 kHz and one period of 19 kHz are added. Therefore each peak level of LEFT signal, RIGHT signal and SUB signal + PILOT signal is 97% with respect to that of MAIN signal + PILOT signal, resulting in 0.26 dB reduction in amplitude level ratio. For this reason, the [LO] indicator goes on more frequently through 【LEFT】, 【RIGHT】, and 【SUB】 key operation.

■ Setting pre-emphasis

Pre-emphasis operates in either of the monaural, stereo, internal modulation, and external modulation modes.

① If the cursor is not at [Pre-em], move it there by using the Pre-em (【F4】) key or the 【△】, 【▽】, 【▷】, and 【◁】 keys.

② Use the rotary knob to set the pre-emphasis to [off] [25 μs] [50 μs] [75 μs].

The standard pre-emphasis characteristic is shown in Fig.2-3. The 20 dB line in the figure stands for the condition under which pre-emphasis is off. When pre-emphasis is set, 20 dB reduction results at the flat portion in lower bands (400 Hz or lower).

Therefore, displayed value of Mod is 1/10.

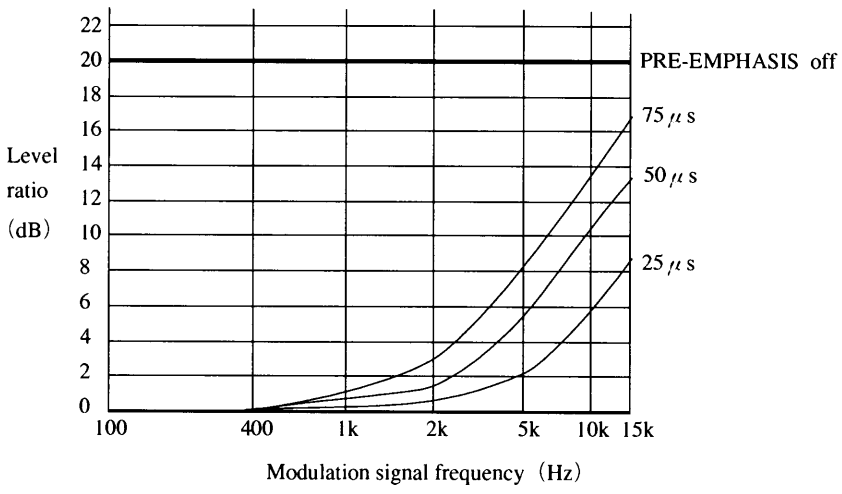


Fig.2-3 Pre-Emphasis Characteristic

For example, pre-emphasis is set to 10% with respect to 100% monaural modulation level. In addition, the overall modulation level after pre-emphasis setting is 19% (= 9% stereo modulation level + 10% pilot level) with respect to 90% stereo modulation level and 10% pilot level.

L-MSK modulation levels are, in the same manner as the pilot level above, added to the overall modulation level.

■ Setting L/R

When the L/R (【F5】) key is pressed, the [LEFT] and [RIGHT] indicator lamps go on at the same time and [Source] is set to [EXT L/R]. The AF/L connector becomes the L (left-side) stereo signal input terminal and the R connector becomes the R (right-side) terminal, enabling external modulation input with two signals.

Adjust the L level so that both the [LEVEL HI] and [LO] indicator lamps are off.

For adjustment of the R level, switch over to the AF/L connector, adjust the R level so that both the [LEVEL HI] and [LO] indicator lamps are off, and then reconnect the R connector.

CAUTION

- Set the modulation signal carefully. The AF/L and R connectors may be in the input or output mode. For certain set conditions, signals might collide and damage KSG3500A. When [EXT L/R] is set, the AF/L and R connectors are in the input mode.

2.3.3 Setting L-MSK Mode

L-MSK provides the <main> and <SDI> screens. Select the screen by 【F5】 key and set necessary items.

Use the 【AUTO】 key to set on/off the automatic level control.

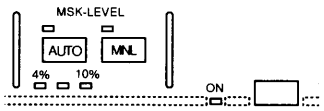
The automatic level control is on when the indicator LED is lit. When it is on, the L-MSK multiple level is automatically controlled to be 4-10%, following the L-R voice modulation level 2.5-5.0% which is the rated value.

Use the 【MNL】 key to set on/off the manual level control.

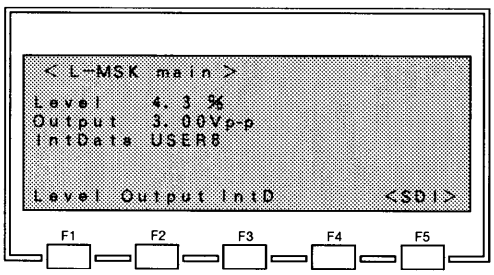
The manual level control is on when the indicator LED is lit. When it is on, the L-MSK level can be set in the range of 0-20% in steps of 0.1%. In this case, the L-MSK indicator is fixed at the center value regardless of the L-R voice modulation level.

There are three indicator LEDs: less than 4%, 4% to less than 10%, and 10%. The indicator can be used to check the operation state.

Use the 【ON】 key to set on/off the FM multiple signal (76 kHz carrier suppression MSK signal). The FM multiple signal is on when the indicator LED is lit.



■ Setting <L-MSK main> Screen



▪ Setting the level

Set the level for L-MSK MNL in the range of 0-20% in steps of 0.1%.

The level value is valid only when the 【MNL】 key of MSK-LEVEL is on (indicator LED lit).

① If the cursor is not at [Level], move it there by using the Level (【F1】) key or the 【△】 , 【▽】 , 【▷】 , and 【◁】 keys.

② Use the rotary knob or numeric keypad to set the level.

Rotary knob: Used to increase or decrease the value at the cursor position.

Numeric keypad: Used to directly set the value. For example, input 【1】 【0】 【ENTER】 to set 10%.

■ Setting the output

Adjust the level of the external modulation signal source such as SG. Set the output in the range of 1.5-10 Vp-p in steps of 0.01 V.

① If the cursor is not at [Output], move it there by using the Output (【F2】) key or the 【△】 , 【▽】 , 【▷】 , and 【◁】 keys.

② Use the rotary knob or numeric keypad to set the output.

Rotary knob: Used to increase or decrease the value at the cursor position.

Numeric keypad: Used to directly set the value. For example, input 【5】 【.】 【5】 【ENTER】 to set 5.5 V.

CAUTION

- When connecting external SG (standard signal generator), check the SG external modulation input sensitivity, set [Output] of KSG3500A to a value not exceeding that sensitivity, and then connect SG to the COMPOSITE OUTPUT connector. Note that if [Output] is higher than the SG input sensitivity, SG might be damaged.

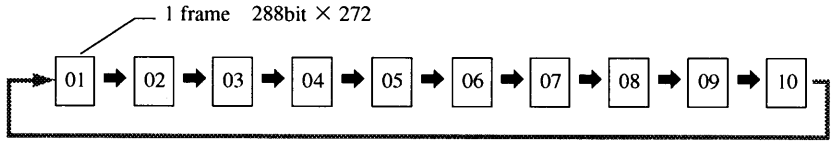
③ To output 100% of the set value, set the monaural/stereo modulation level [Mod] to 100%.

④ Set the voltage equal to the external modulation input sensitivity of the SG to be used in combination. [Output] displays the output level (peak to peak) of KSG3500A.

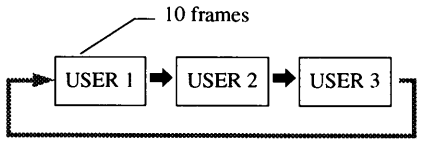
■ Setting IntData

Select the internal data from PN9 and USER1 to USER8.
Internal data USER1 to USER8 has the following structure:

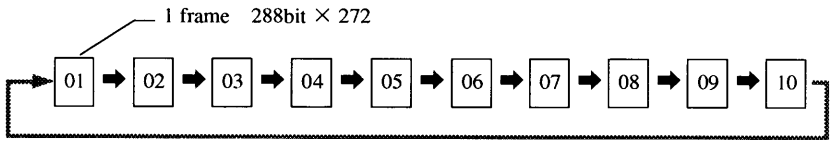
· When USER1, USER2, and USER3 are selected, ten frames are used cyclically as shown below.



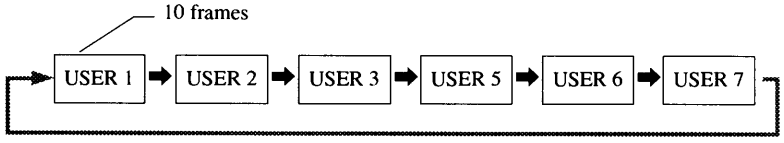
· When USER4 is selected, thirty frames are used cyclically as shown below.



· When USER5, USER6, and USER7 are selected, ten frames are used cyclically as shown below.



· When USER8 is selected, sixty frames are used cyclically as shown below.



Selecting IntData

① If the cursor is not at [IntData], move it there by using the IntD (【F3】) key or the 【△】 , 【▽】 , 【◁】 , and 【▷】 keys.

② Use the rotary knob to set the IntData.

Rotary knob : Used to select the value in the allowable range.

■ Switching to Serial Data Input (SDI) screen

Press the SDI (【 F5 】) key to switch to the <SDI polarity> screen.
For details of the screen, see Section 2.3.4 "Setting DATA Mode."

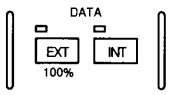
2.3.4 Setting DATA Mode

The external signal mode is set when the 【EXT】 key is pressed.

When the indicator LED is on, the data to be multiplexed can be transferred through the Serial Data Input (SDI) connector on the rear panel.

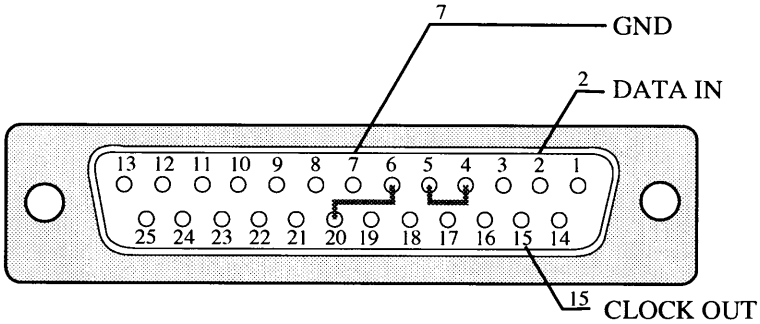
The internal signal mode is set when the 【INT】 key is pressed.

When the indicator LED is on, select the data to be multiplexed from IntData on the <L-MSK main> screen.



■ Inputting external data

Input external data from the SDI connector on the rear panel.



Pin 2 : Data input
Pin 7 : GND
Pin 15 : Clock out 16 kHz

Fig. 2-4 SDI connector

Pins 4 and 5 and pins 6 and 20 are internally connected to each other.

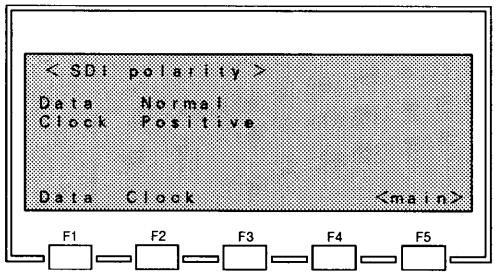
Input data to pin 2 synchronously with the clock at pin 15.

When connecting the serial interface of a personal computer to the SDI connector of KSG3500A, set the external synchronous mode (external 16kHz clock synchronization) and use a straight cable.

NOTE

- To connect a IBM PC-AT compatible PC to the SDI connector, you need a PC with a extended synchronous serial port.

■ Setting <SDI polarity> screen



■ Setting Data

Switch the polarity of data (EXT DATA, PN9) for MSK to [Normal] or [Inverse].

① If the cursor is not at [Data], move it there by using the Data (【F1】) key or the 【△】 , 【▽】 , 【▷】 , and 【◁】 keys.

② Use the rotary knob to set the Data. Turning the knob clockwise to set to [Normal] and counterclockwise to set to [Inverse].

■ Setting clock

Switch the Clock polarity of the clock (16 kHz).

① If the cursor is not at [Clock], move it there by using the Clock (【F2】) key or the 【△】 , 【▽】 , 【▷】 , and 【◁】 keys.

②Use the rotary knob to set the clock. Turning the knob clockwise to set to [Positive] and counterclockwise to set to [Negative].

■ Switching to main screen

Press the main (【F5】) key to switch to the <L-MSK main> screen.

For details of the screen, see 2.3.3 "Setting L-MSK Mode."

2.3.5 Setting BER Mode

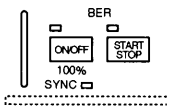
BER provides three screens: <main>, <comp>, and <pol>. Select the screen by the 【F4】 and 【F5】 keys and set the necessary items.

The BER measurement function is set on/off by the 【ON/OFF】 key of BER. This function is on when the indicator LED is lit.

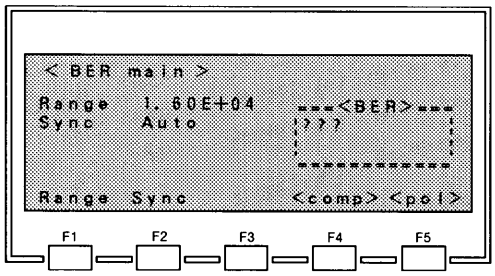
When the BER measurement function is on, the BER area appears in the LCD display and measurement is started by pressing the 【START/STOP】 key.

When [SYNC] indicator LED is lit, synchronous measurement is enabled.

When [SYNC] indicator LED is not lit, synchronous measurement is being prepared, synchronization is disabled, or measurement is being suspended.



■ Setting <BER main> screen



■ Setting Range

Select the measurement range from [1.00E + 02], [2.50E + 03], [1.00E + 04], [1.60E + 04], [1.00E + 05], and [1.00E + 06] (unit: bit).

① If the cursor is not at [Range], move it there by using the Range (【F1】) key or the 【△】 , 【▽】 , 【▷】 , and 【◁】 keys.

② Use the rotary knob to set the range.

■ Setting Sync

Set the bit error meter synchronization mode to [Auto] or [Normal].

When it goes out of synchronism in [Auto] mode, measurement restarts after automatically synchronizing.

In [Normal] mode, measurement continues if it goes out of synchronism.

① If the cursor is not at [Sync], move it there by using the Sync (【F2】 key or the 【△】 , 【▽】 , 【▷】 , and 【◁】 keys.

② Use the rotary knob to set the Sync. Turning the knob clockwise to set to [Auto] and counterclockwise to set to [Normal].

■ Switching to <BER compare> screen

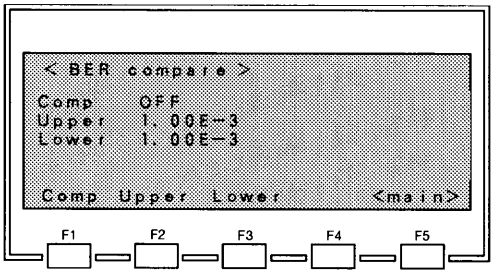
Press the comp (【F4】) key to switch over to the <BER compare> screen.

■ Switching to <BER input polarity> screen

Press the pol (【F5】) key to switch over to the <BER input polarity> screen.

■ Setting <BER compare> screen

Press the comp (【F4】) key to switch from the <BER main> screen to the <BER compare> screen.



■ Setting Comp

Set the comparison mode on/off. When on, comparison is enabled.

① If the cursor is not at [Comp], move it there by using the comp (【F1】) key or the 【△】 , 【▽】 , 【▷】 , and 【◁】 keys.

② Use the rotary knob to set the Comp. Turning the knob clockwise to set to [ON] and counterclockwise to set to [OFF].

■ Setting Upper

Set the upper limit for comparison in the range of 0.00E-06 to 9.99E-01.

① If the cursor is not at [Upper], move it there by using the Upper (【F2】) key or the 【△】 , 【▽】 , 【▷】 , and 【◁】 keys.

②Rotary knob: Used to increase or decrease the value at the cursor position.

Numeric keypad: Used to directly set the value. For example, input 【5】 【・】 【0】 【0】 【−】 【4】 【ENTER】 to set 5.00E-04.

■ Setting Lower

Set the lower limit for comparison in the range of 0.00E-06 to 9.99E-01.

① If the cursor is not at [Lower], move it there by using the Lower (【F3】) key or the 【△】 , 【▽】 , 【▷】 , and 【◁】 keys.

②Rotary knob: Used to increase or decrease the value at the cursor position.

Numeric keypad: Used to directly set the value. For example, input 【5】 【・】 【0】 【0】 【−】 【4】 【ENTER】 to set 5.00E-04.

NOTE

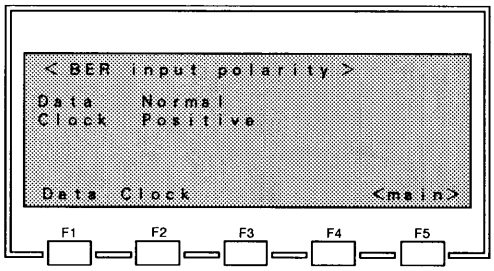
· KSG3500A determines as "Pass" when the measurement value is within the range defined by the Upper and Lower values. If the Upper value is less than the Lower value, comparison is performed by automatically exchanging the values internally.

■ Switching to <BER main> screen

Press the main (【F5】) key to switch to the <BER main> screen.

■ Setting <BER input polarity> screen

Press the pol (【F5】) key to switch from the <BER main> to <BER input polarity> screen.



■ Setting Data

Set the measurement data polarity to [Normal] or [Inverse].

① If the cursor is not at [Data], move it there by using the data (【F1】) key or the 【△】, 【▽】, 【▷】, and 【◁】 keys.

②Use the rotary knob to set the Data. Turning the knob clockwise to set to [Normal] and counterclockwise to set to [Inverse].

■ Setting Clock

Set the measurement clock polarity to [Positive] or [Negative].

①If the cursor is not at [Clock], move it there by using the Clock (【F2】 key or the 【△】, 【▽】, 【▷】, and 【◁】 keys.

②Use the rotary knob to set the Clock. Turning the knob clockwise to set to [Positive] and counterclockwise to set to [Negative].

■ Switching to <BER main> screen

Press the main (【F5】) key to switch to the <BER main> screen.

2.3.6 Short-cut Operations

1) When the 【2nd】 and 【MONO (SET)】 keys are pressed, the following conditions are set, enabling to set the external modulation input level in the FM standard signal generator (SG). This is valid only when [Pre-em] is [off].

- Monaural modulation [Mod]: 100%
- [MOD ON] indicator: ON
- Internal modulation signal [Source]: 1 kHz
- Output level [Output]: 3.00 Vp-p

Set the external modulation input level for the SG appropriately by changing the output level 3.00 Vp-p with the rotary knob. Or, set 100%=75 kHz deviation.

2) When the 【2nd】 and 【MAIN (100%)】 keys are pressed, the following conditions are set. Under these conditions, a superposed signal of the stereo modulation level and pilot level is output.

- Stereo modulation [Mod]: 90%
- Pilot [Pilot]: 10%
- [MAIN] indicator: ON
- [PILOT ON] indicator: ON
- [MOD ON] indicator: ON

NOTE

- The [LEVEL HI] and [LO] lamps may go on alternately when changing over between MAIN, LEFT, RIGHT, and SUB.

  In this case, no problems occur because the range defined by [LEVEL HI] and [LO] are very narrow.

  When the 【 MONO】 key is selected, monaural 90% modulation is set and the [LO] indicator LED goes on.

3) When the 【2nd】 and 【LEFT (30%) 】 keys are pressed, the following conditions are set. The total modulation level goes to 37% which is the sum of the stereo modulation level 90% x 0.3 = 27% and the pilot level 10%.

- Stereo modulation [Mod]: 27%
- Pilot [Pilot]: 10%
- [MAIN] indicator: ON
- [PILOT ON] indicator: ON
- [MOD ON] indicator: ON

4) When the 【2nd】 and 【EXT(10%)】 keys are pressed, the following conditions are set. A 105% signal which is the sum of the stereo modulation level 85%, pilot level 10%, and MSK modulation level 10% (when the MSK LEVEL MNL LED is on).

- Stereo modulation [Mod]: 85%
- Pilot [Pilot]: 10%
- MSK modulation [Level]: 10%
- [MAIN] indicator: ON
- [PILOT ON] indicator: ON
- [MOD ON] indicator: ON
- [L-MSK ON] indicator: ON

2.3.7 Storing and Recalling Data to/from Memory

The memory of the KSG3500A consists of a 10 x 10 matrix, allowing a total of 100 different settings to be stored.

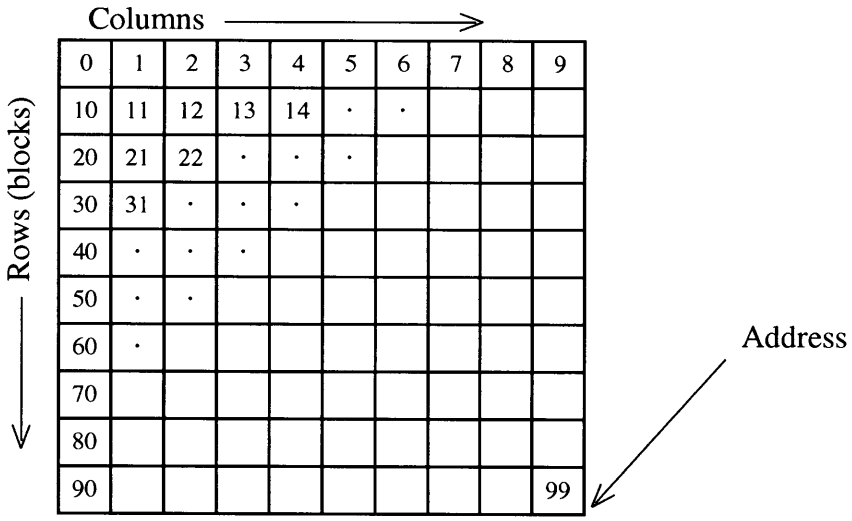


Fig.2-3 Memory Matrix

CAUTION

- Data is to be stored in the address which is specified first after store operation is specified. Make sure that the address specification is correct.

1) Address Specification

■ Direct Specification (by Numeric Keypad)

▪ Store

Press 【2nd】, 【STO】, 【 · 】, row number (block), and then column number. To store data in address 25, press 【2nd】, 【STO】, 【 · 】, 【2】 and 【5】.

▪ Recall

Press 【RCL】, 【 · 】 row number (block), and then column number. To recall data from address 25, press 【RCL】, 【 · 】, 【2】 and 【5】.

NOTE

· The 【—】 key can be used as a wild card of the row number (block). When address 25 is recalled, pressing 【RCL】, 【 · 】, 【—】, 【8】 recalls address 28.

■ Specification with 【△】 and 【▽】 Keys

The 【△】 and 【▽】 keys can be used to specify the column number.

▪ Store

Press the 【RCL】 key, input the row (block) number, select the target column number minus 1 by pressing the 【△】 or 【▽】 key, and then select the target address by pressing the, and 【△】 key.

For example, when storing at 25, press the 【RCL】 and 【2】 keys, set 24 by the 【△】 and 【▽】 keys, then store the data by pressing the 【2nd】 【STO】, and 【△】 keys.

▪ Recall

Press [RCL], row number (block), and 【△】 / 【▽】 to specify the column number.

To specify address 25, press 【RCL】, 【2】, and then 【△】 five times.

■ Specification of the Column Number

This method is used to limit the 【△】 and 【▽】 cycle for the column number in a block. Specify the block and column number for which cycle is to be limited by direct specification and then press 【2nd】, 【STO】 and 【RTN】. The column number is displayed in cyclic manner.

Example

To cycle block 2 in columns 0-6, press the 【2nd】, 【STO】, 【 · 】, 【2】, and 【6】 keys or press 【RCL】, 【 · 】, 【2】, and 【6】 by direct specification. Then, press the 【2nd】, 【STO】 and 【RTN】 keys.Thus 【△】 and 【▽】 keys can be used to set column numbers 0-6.

20→21→22→23→24→25→26→RETURN→20→21→ · · · ·

NOTE

· If cycle specification of column number is made when column number is 0, only the top column can be selected.

To cancel cycle specification, set the limited column number of the specified block as cycle 0 to 9 again. In the above example, press 【RCL】, 【 · 】, 【2】, 【9】 by direct specification, and then press 【2nd】, 【STO】 and 【RTN】.

■ Consecutive Address Setting

Normally, the address is specified in cyclic manner within a block. Consecutive address setting allows address specification in two or more consecutive blocks.

① Recall column 9 in the first block of the blocks to be consecutive.

② Press 【2nd】, 【STO】, and 【NEXT】 to allow subsequent blocks to be selected or displayed in succession.

Example

To make blocks 3 and 4 consecutive, press the 【RCL】, 【 · 】, 【3】, and 【9】 keys, and then the 【2nd】, 【STO】, and 【NEXT】 keys. Now, the 【△】 and 【▽】 keysan be used to set column numbers 30-49 in step 20.

· · · · →38→39→NEXT→40→41→ · · · ·

To cancel consecutive address setting, replace NEXT with RETURN.

By pressing the 【RCL】 and 【 · 】 keys and inputting the row (block) number and the column number, recall the last address of those to be canceled, and then press the 【2nd】, 【STO】, and 【RTN】 keys.

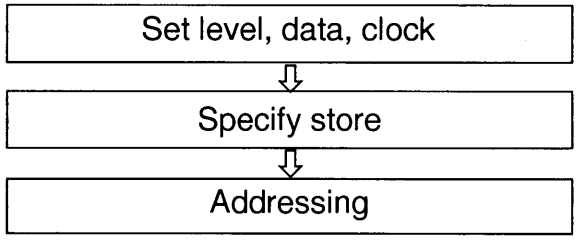
In the above example, press 【RCL】, 【 · 】, 【3】, and 【9】 keys by direct specifications, and then press the 【2nd】, 【STO】, and 【RTN】 keys.

2) Basic Store Operation

CAUTION

- The contents of the <REMOTE Setup> screen are not stored in memory by the memory store operation, nor read by the recall operation. They are read only once when the 【POWER】 switch is turned on.
- Data is to be stored in the address which is specified first after store operation is specified. Make sure that the address specification is correct. When the address has not yet been specified, the [STO] indicator goes on; when it has been specified, the indicator goes off.

The basic operation flow includes setting the level, data, and clock, specifying store, and addressing.



■ Successive Store within a Block

① Press 【2nd】, 【STO】, and row number (block) to store data in the first column of the specified block.

② Press 【2nd】, 【STO】, and 【△】 to store data in the next column.

Example

Storing data in addresses 20 and 21

Make level, data, and clock polarity setting, and then press 【2nd】, 【STO】, and 【2】 to store data in address 20. Then make another setting and press 【2nd】, 【STO】, and 【△】 to increment the column number. Data is stored in address 21.

■ Direct Store

① Press 【2nd】, 【STO】, row number (block), and column number to store data in the specified address directly.

Example

Storing data at address 25

Set the level, data, and clock polarity, and then press the 【2nd】, 【STO】, 【 · 】, 【2】, and 【5】 keys.

3) Basic Recall Operation

■ Successive Recall within a Block

① Press 【RCL】 and row number (block) to recall a block, and then press 【△】 / 【▽】 to select the column number.

Example

Recalling block 2

Press the 【RCL】 and 【2】 keys to recall address 20. Then, press the 【△】 or 【▽】 key to select the column number.

■ Direct Recall

① Press 【RCL】, 【 · 】, row number (block), and column number to recall the specified address directly.

Example

Recalling address 25

Press the 【RCL】, 【 · 】, 【2】, and 【5】 keys.

NOTE

- After direct recall, pressing 【△】 / 【▽】 selects the address prior or next to the current one.

Chapter 3 Remote Control

This chapter describes external controls such as the GPIB and RS-232C interfaces.

KSG3500A has the GPIB interface and the SIO interface (conforming to RS-232C).

3.1 GPIB Interface

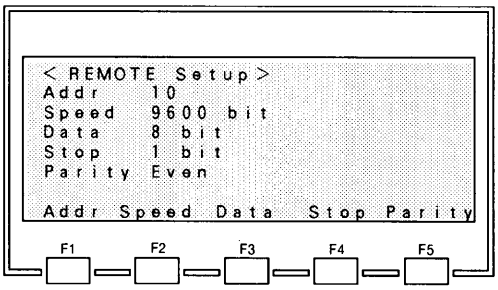
1) Overview

The GPIB interface of the KSG3500A is controlled by means of the IEEE488 standard interface bus. The electrical and mechanical specifications of the interface conform to IEEE std 488.1-1987.

2) Using GPIB interface

■ Setup

① Turn the 【POWER】 switch off and connect the GPIB cable.
② Turn on the 【POWER】 switch.
③ Press the 【2nd】 and 【LOCAL】 keys to display the <REMOTE Setup> screen.
④ Check the device address of the GPIB interface. [Addr] indicates the device address which is set to "10" at the time of shipment.



■ Device address setting

A number from 0 to 30 can be set as a device address.

① Press the 【2nd】 and 【LOCAL】 keys to display the <REMOTE Setup> screen.

The device address is displayed at [Addr].

② If the cursor is not located on [Addr], move it to [Addr] using the Addr (【F1】) key or the 【△】 , 【▽】 , 【▷】 , and 【◁】 keys.

③ [Addr] setting is made using the rotary knob or numeric keypad.

Rotary knob : Increments and decrements the digit at the cursor position.

Numeric keypad : Allows direct address setting by entering a number. For example, to set address 20, press 【2】, 【0】, and 【ENTER】.

CAUTION

- When the device address has been set, turn off the power and then turn it back on.
- The address is not updated before the power is switched off and then switched on.

■ Sample program

See the sample programs given in Appendices 1-3.

These programs control KSG3500A through the GPIB and RS-232C using BASIC language for NEC PC9801. At the end of BER measurement, they read the error rate and judgment results by an SRQ interrupt. The program in Appendix 3 transfers FM multiple data to KSG3500A through the GPIB interface.

3.2 SIO Interface (Conforming to RS-232C)

1) Overview

The serial interface function of the KSG3500A conforms to EIA RS-232C standard.

1) Communication protocol including transmission rate can be set in arbitrary manner.
2) GPIB remote/local functions can be realized by the serial interface.

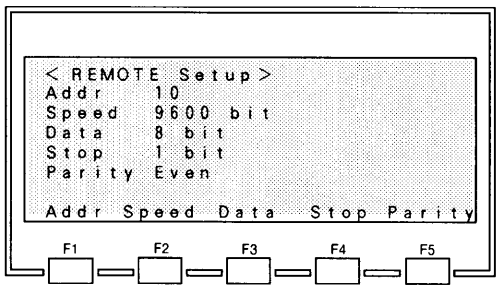
2) Using SIO interface

■ Setup

① Turn the 【POWER】 switch off and connect the RS-232C cable (straight type).

② Turn on the 【POWER】 switch.

③ Press the 【2nd】 and then 【LOCAL】 keys to display the <REMOTE Setup> screen.



■ Protocol Setting

CAUTION

- Upon completion of protocol, turn the power back on.
- The protocol information is not updated before the power is switched off and then switched on.

Press the 【2nd】 and then 【LOCAL】 keys to display the <REMOTE Setup> screen. Protocol settings include [Speed], [Data], [Stop], and [Parity].

■ Speed setting

Speed settings include [300], [600], [1200], [2400], [4800], and [9600] (bps). [9600] is set at the time of shipment.

① If the cursor is not at [Speed], move the cursor to it using the Speed (【F2】) key or the 【△】 , 【▽】 , 【▷】 , and 【◁】 keys.

② Speed setting is made using the rotary knob.

■ Data bit setting

Data bit settings include [7] and [8] (bits). [8] is set at the time of shipment.

① If the cursor is not at [Data], move the cursor to it using the Data (【F3】) key or the 【△】 , 【▽】 , 【▷】 , and 【◁】 keys.

② Data bit setting is made using the rotary knob.

■ Stop bit setting

Stop bit settings include [1] and [2] (bits). [1] is set at the time of shipment.

① If the cursor is not at [Stop], move the cursor to it using the Stop (【F4】) key or the 【△】 , 【▽】 , 【▷】 , and 【◁】 keys.

② Stop bit setting is made using the rotary knob.

■ Parity bit setting

Parity bit settings include [None], [Odd], and [Even]. [None] is set at the time of shipment.

① If the cursor is not at [Parity], move the cursor to it using the Parity (【F5】) key or the 【△】 , 【▽】 , 【▷】 , and 【◁】 keys.

② Parity bit setting is made using the rotary knob.

NOTE

· The following combinations cannot be specified:

1) [Data] : 8bit、 [Stop] : 2bit、 [Parity] : Odd

2) [Data] : 8bit、 [Stop] : 2bit、 [Parity] : Even

3) [Data] : 7bit、 [Parity] : None

3) Control Method

The connector of the KSG3500A is designed as data circuit termination equipment (DCE) of the RS-232C.

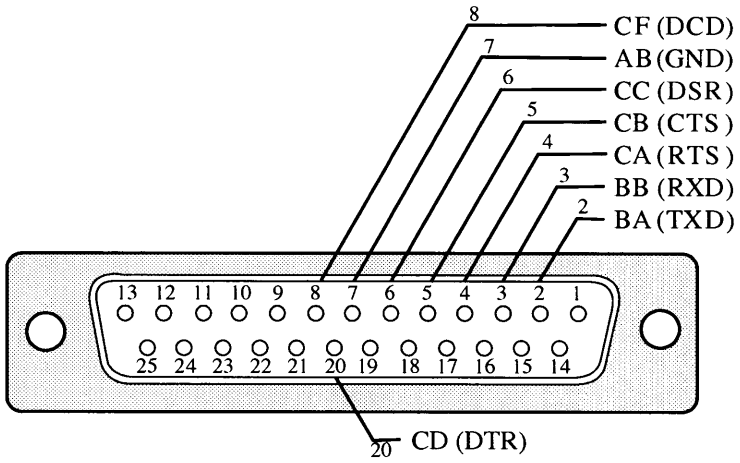


Fig. 3-1 Connector pin layout

■ Transferring command/query

When sending the program code to the KSG3500A, set CA (RTS) to ON, wait until CB (CTS) is set to ON, and send the program code to BA (TXD). Set CB (CTS) to ON and OFF for each character.

■ Reading data

When a query with '?' followed by ACK (06H) is sent to KSG3500A, the read data is sent to BB (RXD). If ACK is sent before the send data is not ready, NAK (15H) is received.

■ Sample Program

See the sample programs given in Appendix 2.

This program controls KSG3500A through the RS-232C interface using PC-9801 and N88BASIC. The program polls the BER meter status and, at the end of the measurement, reads the error rate and judgment results.

3.3 Remote Control Using the Remote Connector

1) Overview

The KSG3500A is provided with a remote connector on the rear panel, which are used to control front panel key operations remotely.

NOTE

- "1" and "0" used in the following description correspond to "High" and "Low" of the TTL level, respectively.

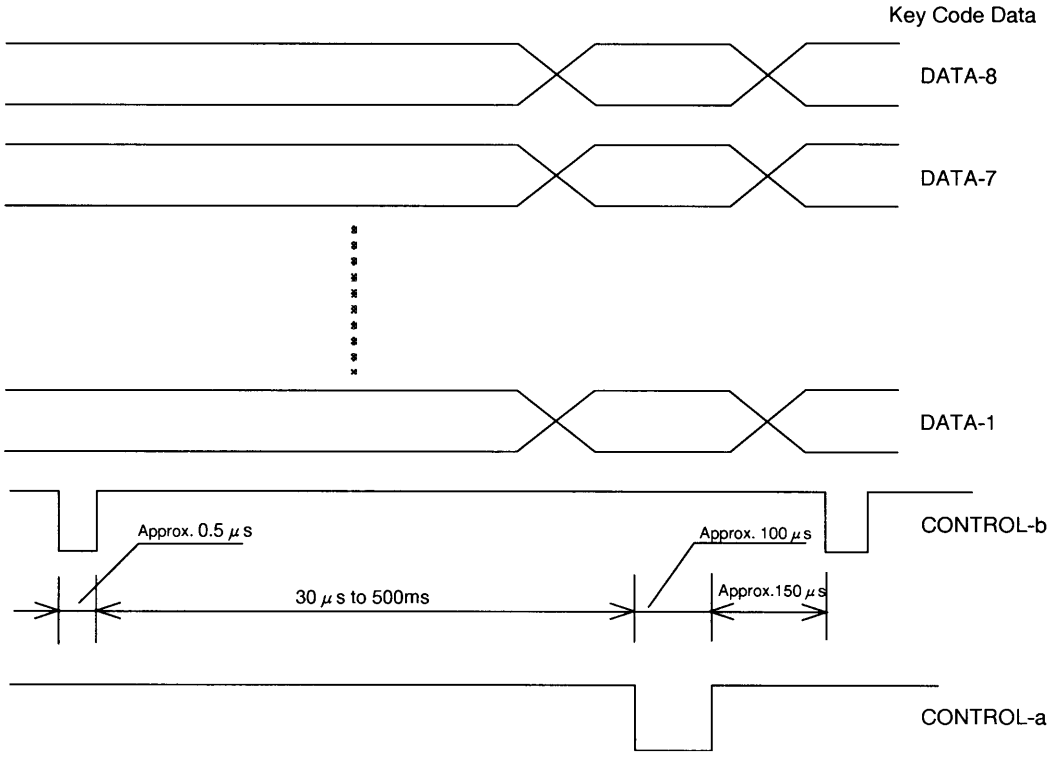


Fig.3-2 Timing Chart

CONTROL-b : This signal requests data read by outputting "0" for 0.5 μ s or more.

CONTROL-a : Outputs "0" for about 100 μ s, 30 μ s to 500 ms after reception of the signal CONTROL-b. In this duration, data is read.

For 150 μ s after the level is set back to "1", the signal CONTROL-b cannot be received.

DATA-1 to 8 : This key code data must be retained while the signal CONTROL-a is "0".

2) Remote Connector

■ Description of pins

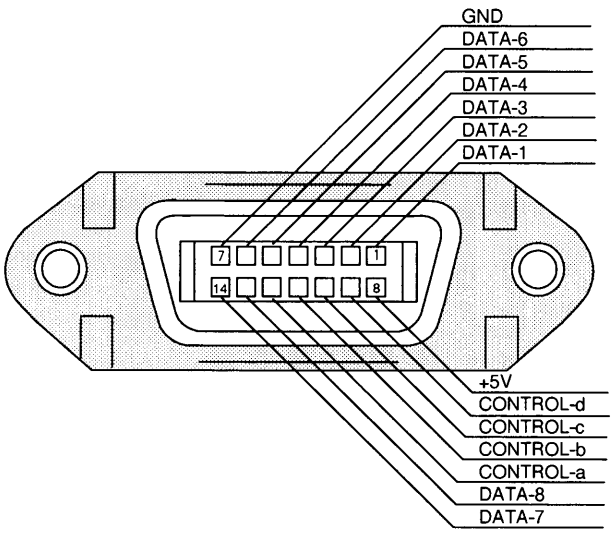


Fig.3-3 the Remote Connector

1) DATA-1 to -8 (Pin Nos.1 to 6, 13, and 14)

The DATA lines form a bi-directional data bus which can be used for input and output. Because the data bus is bi-directional, if "0" or "1" is applied to DATA-1 to -8 directly, the KSG3500A does not operate.

2) CONTROL (Pin Nos.9 to 12)

- CONTROL-a: DATA STROBE output terminal (pin No.12)
  Outputs "1" normally or "0" to read data.
- CONTROL-b: REQUEST TO READ input terminal (pin No.11)
  Outputs "1" normally or "0" to request data read.
- CONTROL-c: Display control output terminal (pin No.10)
  When "1", data processing is performed.
- CONTROL-d: Display control output terminal (pin No.9)
  When "1", data processing is performed.
  Outputs a square wave with a width of about 13 ms and a period of about 87.6 ms continuously.

3) +5V terminal : Remote control power terminal (pin No.8)

Maximum current output: 100 mA

4) GND terminal: Ground terminal (pin No.7)

Connected to the chassis.

3) Panel Key Code Table

Every key on the panel is assigned a code.

When a key code shown in Table 3-1 below is specified, setting the signal CONTROL-b to "0" is equivalent to pressing the corresponding key on the panel.

	DATA INPUT PIN NUMBER					
	6	5	4	3	2	1
KEY NAME	MSB ← Key Code → LSB					
RCL/STO	0	0	0	1	0	0
▽/RTN	0	0	0	1	1	1
△/NEXT	0	0	0	1	1	0
F1	0	0	1	0	0	1
F2	0	0	1	0	1	1
F3	0	0	1	1	0	0
F4	0	1	0	0	0	0
F5	0	1	0	0	0	1
MONO(SET)	1	0	1	0	0	1
MAIN(100%)	0	1	1	1	0	0
LEFT(30%)	0	1	1	1	0	1
RIGHT	0	1	1	1	1	0
SUB	0	1	1	1	1	1
MOD ON	0	0	1	1	1	1
PILOT ON	0	0	1	1	1	0
AUTO	1	0	0	1	1	0
MNL	1	0	0	1	1	1
EXT	1	0	1	0	0	0
INT	1	0	0	0	0	1
ON	1	0	0	1	0	0
ON/OFF	1	0	0	0	1	0
START/STOP	1	0	0	0	1	1
2nd	0	1	1	0	1	1
STEREO	0	1	0	0	1	0
L-MSK	0	1	0	0	1	1
BER	0	1	0	1	0	0
ENTER	0	0	1	0	1	0
MHz	0	1	0	1	1	0
kHz	1	0	0	1	0	1
0	1	1	0	0	0	0
1	1	1	0	0	0	1
2	1	1	0	0	1	0
3	1	1	0	0	1	1
4	1	1	0	1	0	0
5	1	1	0	1	0	1
6	1	1	0	1	1	0
7	1	1	0	1	1	1
8	1	1	1	0	0	0
9	1	1	1	0	0	1
·	1	0	1	1	1	0
—	1	0	1	1	0	1
⇦	0	0	1	0	0	0
△	0	1	0	1	1	1
▽	0	1	1	0	0	0
◁	1	1	1	1	0	0
▷	1	1	1	1	1	0
ROTARY KNOB(C.W)	0	0	0	0	0	0
ROTARY KNOB(C.C.W)	0	0	0	0	0	1
LOCAL	1	0	1	1	1	1

Table 3-1 Key Code Table

NOTE

- The DATA lines form a 8-bit data bus and therefore set DATA8 (pin No.13) and DATA7 (pin No.14) to "1".

4) Performing Recall Using Remote Control

Recalling memory 57

① Set "000100" which corresponds to 【RCL】 key.

② While the signal CONTROL-b is "0", data is read.

③ Set the key code of the 【 · 】 key ("101110") and then set the signal CONTROL-b to "0".

④ Set the key code of the 【5】 key ("110101") and then set the signal CONTROL-b to "0".

⑤ Set the key code of the 【7】 key ("110111") and then set the signal CONTROL-b to "0".

When the signal CONTROL-a becomes "0", recall processing is started.

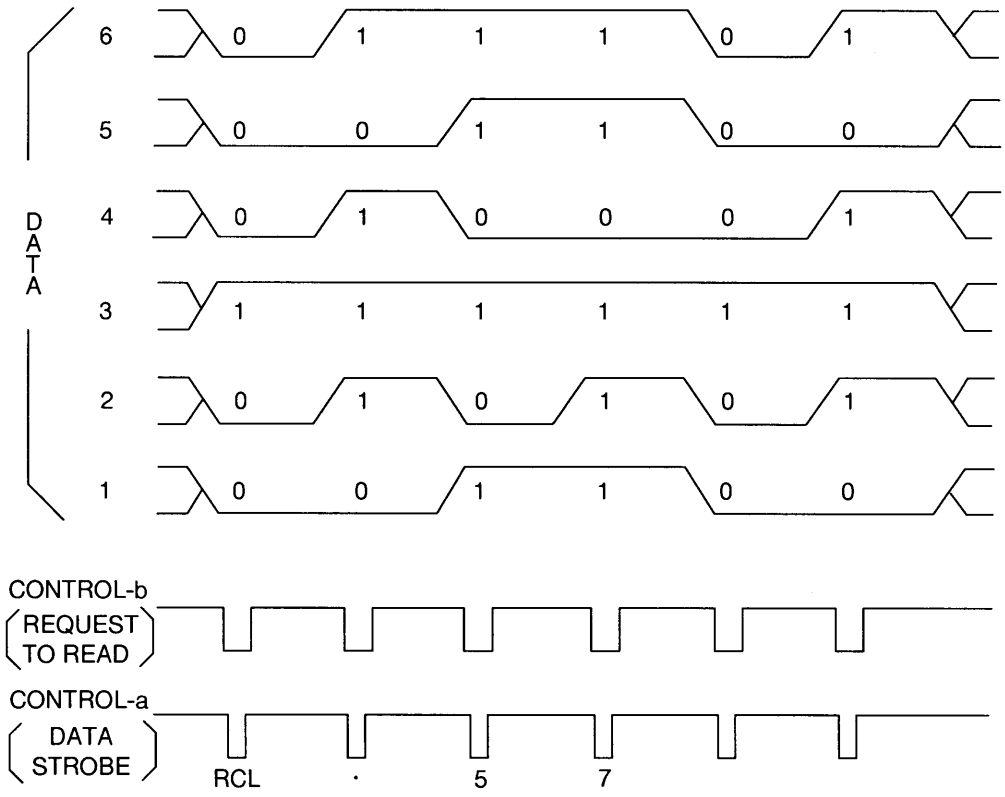


Fig.3-4 Time Chart for Recall "57"

Example remote control circuit and operation

Since the data line of the remote control connector is a bi-directional bus, the circuit shown below is recommended for remote control of the KSG3500A.

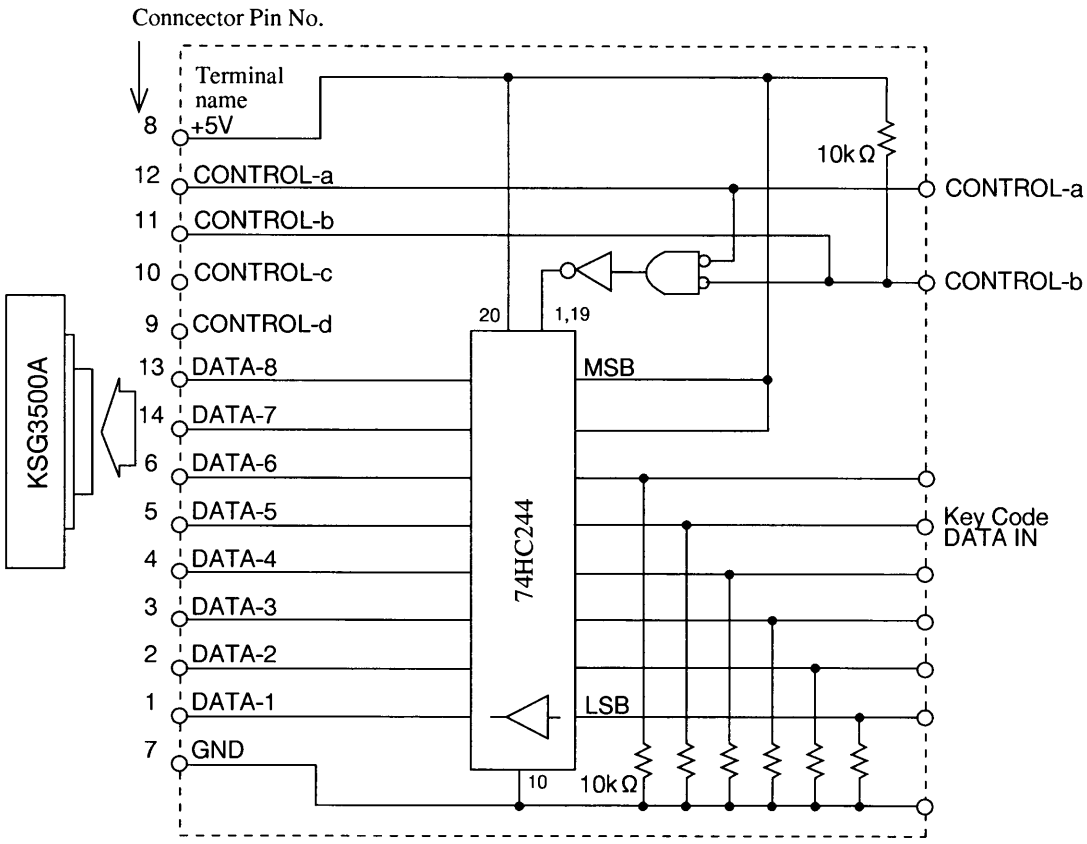


Fig.3-5 Example Remote Circuit

① When the signal CONTROL-b is "1", set DATA-1 to -6.

② Wait for 10 μ s or more, set the signal CONTROL-b to "0".

③ The signal CONTROL-a becomes "0" within 30 μ s to 500 ms.

Set Enable A and B (pin Nos.1 and 19) to "0" and then perform key code capture processing while the signal CONTROL-a is "0" (for about 100 μ s).

④ Upon completion of capture processing, the signal CONTROL-a becomes "1". Confirm this signal and then set the next key code.

Key code data can be input in succession by repeating the above procedure.

NOTE

- When inputting key code data in succession, if the signal CONTROL-b is set to "0" before key code data processing is completed, it takes up to approx. 500 μs till the signal CONTROL-a is output.
- The DATA line consists of eight bits. Send "1" to DATA-8 (pin 13) and DATA-7 (pin 14) via the 74HC244.

The timing chart of the example remote control circuit is shown in Fig.3-6.

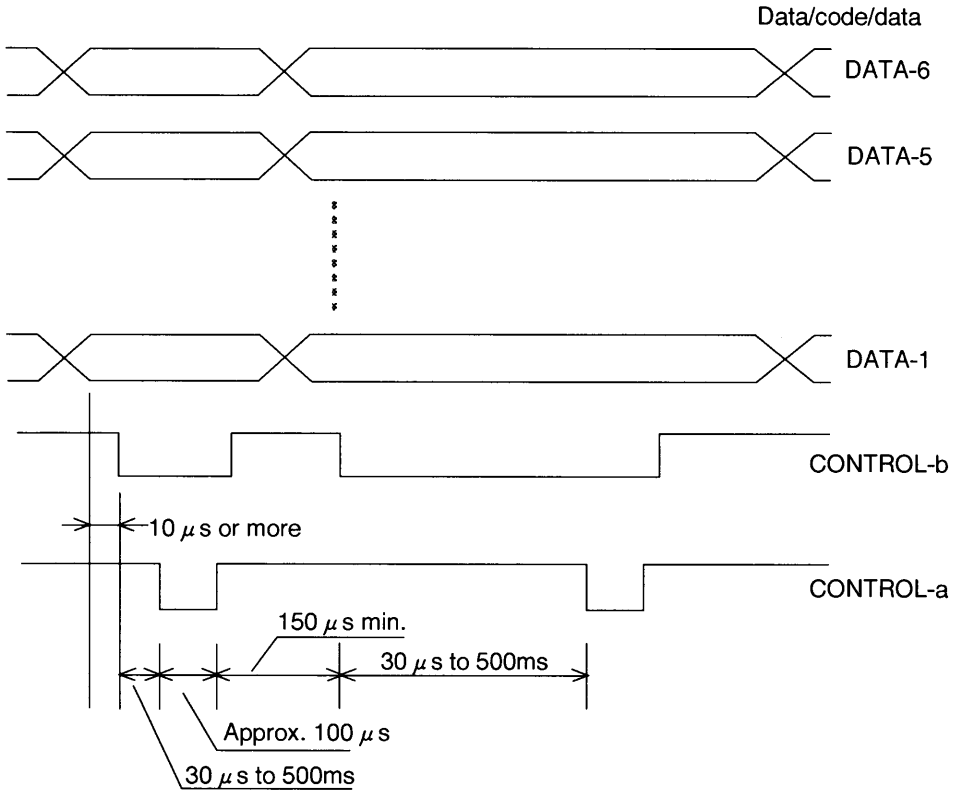


Fig.3-6 Timing Chart of the Example Remote Circuit

5) Example output circuit of the MEMORY display unit

Since the remote control terminal has a bi-directional bus configuration, data can be output in the same manner as the MEMORY display unit on the panel. In addition, when a latch is used instead of the CMOS4511, MEMORY display unit data can be used.

When the circuits in Figs.3-5 and 3-7 are connected in parallel at the connector, remote control of the KSG3500A as well as internal MEMORY display and data check are allowed.

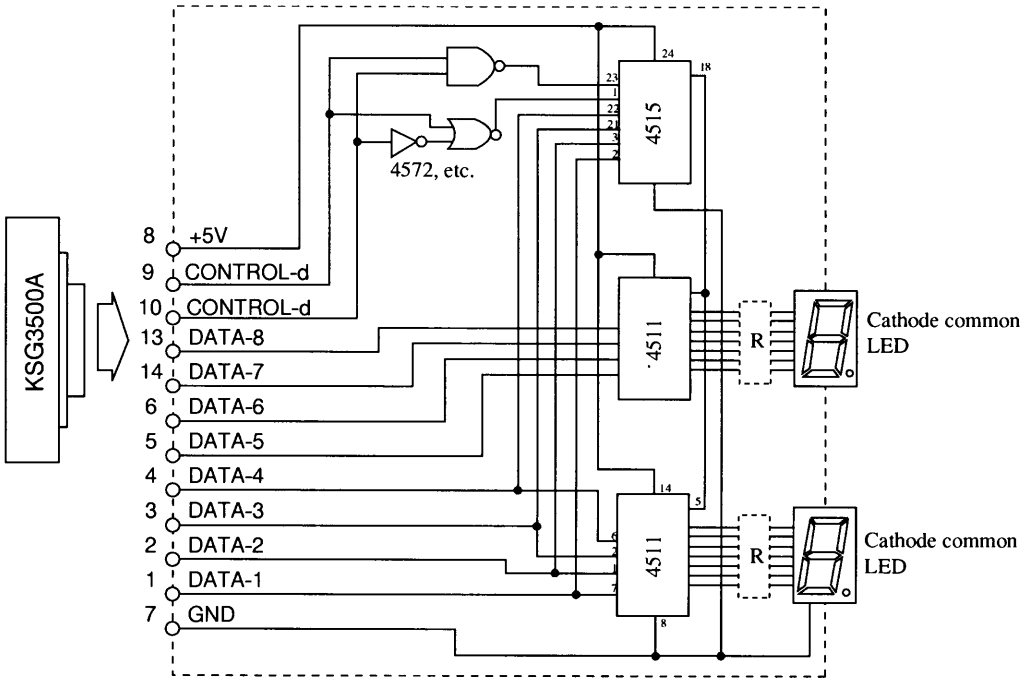


Fig.3-7 Example Output Circuit of the MEMORY Display Unit

3.4 Program Code

1) Program code overview

■ Outline

A program code is written in ASCII code.

A command consists of a header and parameters and its maximum length is 128 characters.

The program code is not case sensitive.

■ Header

A header must be a predetermined string consisting of two or more letters.

■ Parameter

A string that follows the header, consisting of alphanumeric characters and a letter indicating the unit.

In the program code description, the following conventions are used:

{} : In command input, this symbol indicates that one string should be selected from those separated with " | ."

[] : A string enclosed in brackets is optional.

_ : Indicates a space ('_' 20H).

s : Indicates a string of alphanumeric characters.

n : Indicates an arbitrary integer.

d : Indicates one of digits 0-9.

r : Indicates an arbitrary real number.

■ Delimiter (terminator)

A delimiter (terminator) indicates the end of a command. It must be CR + LF (0DH + 0AH). For GPIB, it may be replaced with CR + LF (EOI signal).

■ Separator

A separator separates between commands. It must be a space ('_' 20H), comma (',' 2CH), slash ('/' 2FH), or semicolon (';' 3BH).

■ Query

A question mark ? ('?' 3FH) following a header indicates that the command is a read command, or query.

If read operation is performed without sending a query, only CR + LF (0DH + 0AH) is returned.

In the program description, the response to the query is indicated succeeding the" ➡" mark.

2) Program code description

■ System command

▪ Screen change command PLAN (switch PLAN e)

A command/query for changing the menu screen.

PLANs

s	Screen name	Command format
STER	<Stereo>	PLANSTER
MSKM	<L-MSK main>	PLANMSKM
MSKS	<L-MSK sdi>	PLANMSKS
BERM	<Berm main>	PLANBERM
BERC	<Berm comp>	PLANBERC
BERP	<Berm pol>	PLANBERP

PLAN ? ➡ {STER | MSKM | MSKS | BERM | BERC | BERP}

■ SRQ enable command SRQ (Service ReQuest)

A command/query for enabling or disabling the GPIB interface service request function.

The SRQ command applies only to the GPIB interface.

SRQs

s	Control	Command format
ENA	Enable	SRQENA
DIS	Disable	SRQDIS
(OUT	SRQ ON	SRQOUT pseudo srq_on)

SRQ ? ➡ {ENA | DIS}

Status byte bit layout

2^0 : End of measurement

2^1 : 0

2^2 : 0

2^3 : 0

2^4 : 0

2^5 : 0

2^6 : rsv (reserved)

2^7 : 0

The status byte is reset when it is read.

■ Memory recall command RC (ReCall)

A command for reading all settings from the memory.

RCn

n	Control	Command format (example)
n	Memory number	RC10

$0 \leqq n \leqq 99$

■ Memory store command ST (memory STore)

A command for storing all settings in memory.

STn

n	Control	Command format (example)
n	Memory number	ST02

$0 \leqq n \leqq 99$

■ Memory query MEM (MEMory)

A query for reading the number of the memory currently called.

MEM ? ➡ {0 to 99}

■ Remote command REM (set REMote)

A command for setting KSG3500A in remote state.

The REM command applies only to the RS-232C interface.

REM

Command format
REM

■ Local command LOC (set LOCal)

A command for setting KSG3500A in local state.

The LOC command applies only to the RS-232C interface.

LOC

Command format
LOC

■ Local Lock-out command LLO (Local Lock Out)

A command for locking KSG3500A out.

The LLO command applies only to the RS-232C command.

LLO

Command format
LLO

■ Go-to-local command GTL (Go To Local)

A command for changing KSG3500A from the local lock-out state to the local state.

The GTL command applies only to the RS-232C command.

GTL

Command format
GTL

■ Device clear command DCL (Device CLear)

A command for initializing KSG3500A.

The DCL command applies only to the RS-232C command.

DCL

Command format
DCL

■ Identification query IDN (IDeNtification)

A query for reading the KSG3500A model name and ROM version, etc.

IDN ? ➡KSG3500A ver 1 . ** (date) . . . |

■ Error query ERR (ERRor)

A query for reading the syntactic judgment result of the command already input.

ERR ? ➡ |0 | 1|

0: No error

1: An error occurred in the previously input command.

Note

· An error, if any, is reset when it is read.

■ Stereo commands

▪ Stereo command SMOD (Stereo MODe)

A command/query for controlling stereo mode.

SMODs

s	Setting	Command format
OFF	Stereo off	SMODOFF
MAIN	Main	SMODMAIN
LEFT	Left	SMODLEFT
RIGHT	Right	SMODRIGHT
SUB	Sub	SMODSUB
EXT	External L/R	SMODEXT
MONO	Monoral	SMODMONO

SMOD ? ➡ {OFF | MAIN | LEFT | RIGHT | SUB | EXT | MONO}

▪ Modulation command MOD (MODulation)

A command/query for controlling/setting the modulation level.

MOD {s | r [{pc | %}] }

s	Control	Command format (example)
ON	On	MODON
OF	Off	MODOF
r	Modulation range (%)	MOD85.0

$0.0 \leqq r \leqq 100.0$

MOD ? ➡ {ON | OF} _ddd.d (0.0 to 100.0)

▪ Pilot command PL (PiLot)

A command/query for controlling/setting the pilot level.

PL {s | n [{PC | %}] }

s	Control	Command format (example)
ON	On	PLON
OF	Off	PLOF
n	Modulation range (%)	PL10

$0 \leqq n \leqq 15$

PL ? ➡ {ON | OF} _dd (0 to 15)

■ Source command SRC (SouRCe)

A command/query for selecting the modulation source.

SRCs

s	Setting	Command format
EXT	external	SRCEXT
30 [Hz]	30 Hz	SRC30
100 [Hz]	100 Hz	SRC100
400 [Hz]	400 Hz	SRC400
1k [Hz]	1 kHz	SRC1k
6.3k [Hz]	6.3 kHz	SRC6.3k
15k [Hz]	15 kHz	SRC15k

SRC ? ➡ {EXT | 30 | 100 | 400 | 1 k | 6.3 k | 15 k}

■ Pre-emphasis command PRE (PREemphasis)

A command/query for controlling/setting the pre-emphasis.

PREs

s	Setting	Command format
OF	Off	PREOF
25 [us]	25 μ s	PRE25
50 [us]	50 μ s	PRE50
75 [us]	75 μ s	PRE75

PRE ? ➡ {OF | 25 | 50 | 75}

■ L-MSK commands

■ On/off command MSK (L-MSK ON/OFF)

A command/query for setting the L-MSK modulation on/off.

MSKs

s	Setting	Command format
ON	On	MSKON
OF	Off	MSKOF

MSK ? ➡ {ON | OF}

■ Data command DATA (DATA select)

A command/query for selecting data for the L-MSK modulation.

DATAs

s	Setting	Command format
EXT	External	DATAEXT
PN9	PN9	DATAPN9
USER1	USER1	DATAUSER1
USER2	USER2	DATAUSER2
USER3	USER3	DATAUSER3
USER4	USER4	DATAUSER4
USER5	USER5	DATAUSER5
USER6	USER6	DATAUSER6
USER7	USER7	DATAUSER7
USER8	USER8	DATAUSER8

DATA ? ➡ {EXT | PN9 | USER1 | USER2 | USER3 | USER4 | USER5 | USER6 | USER7 | USER8}

■ Level command LEV (LEVel)

A command/query for setting the L-MSK modulation level.

LEV {s | r [{% | PC}] }

s	Setting	Command format (example)
AUT	Auto	LEVAUT
r Modulation level (%)	0.0 ≦ r ≦ 20.0	LEV0.0

LEV ? ➡ {AUT | dd.d (0.0 to 20.0) }

■ Output command OUT (OUTput)

A command/query for for setting the output level.

OUTr [Vp-p]

r	Output value (Vp-p)	Command format (example)
	1.50 ≦ r ≦ 10.00	OUT1.50

OUT ? ➡dd.dd (1.50 to 10.00)

■ External data command SDID (Serial Data In Data polarity)

A command/query for selecting the polarity of external data for the L-MSK modulation.

SDIDs

s	Setting	Command format
NOR	Normal	SDIDNOR
INV	Inverse	SDIDINV

SDID ? ➡ {NOR | INV}

■ External clock command SDIC (Serial Data In Clock polarity)

A command/query for selecting the polarity of the external clock for the L-MSK modulation.

SDICs

s	Setting	Command format
POS	Positive	SDICPOS
NEG	Negative	SDICNEG

SDIC ? ➡ {POS | NEG}

■Signal transfer commands

■ Signal write command SIGWRT (SIGnalWRiTe)

A command for informing the optional memory that signal data (10 frames) will be transferred.

SIGWRTs

s	Setting	Command format
USER1	USER1	SIGWRTUSER1
USER2	USER2	SIGWRTUSER2
USER3	USER3	SIGWRTUSER3
USER4	USER4	SIGWRTUSER4
USER5	USER5	SIGWRTUSER5
USER6	USER6	SIGWRTUSER6
USER7	USER7	SIGWRTUSER7
USER8	USER8	SIGWRTUSER8

SIGWRTUSER1 specifies the transfer destination. In approximately 100 ms after that, it transfers binary data of 10 frames (97920 bytes).

The last byte is accompanied by EOI. Then, the SIGEND command is transferred to end the transfer processing.

Transfer 30 frames to USER4 and 60 frames to USER8.
For data bit layout, see the sample program in Appendix 3.

Note

· Signal transfer commands apply only to the GPIB interface.

■ Signal write end command SIGEND (SIGnalEND)

A command for informing the optional memory that the signal data transfer has been completed.

SIGEND

■ BERM commands

■ BER control command BERM (Bit Error Rate Meter)

A command/query for controlling the BER meter.

BERMs

s	Control	Command format
ON	On	BERMON
OF	Off	BERMOF

BERM ? ➡ {ON | OF}

■ BER measurement execution command BER (Bit Error Rate)

A command/query for starting/stopping the BER meter.

BERs

s	Control	Command format
STR	Start	BERSTR
STP	Stop	BERSTP

BER ? ➡ {STR | STP}

■ Range command RANG (RANGe)

A command/query for selecting the range for the error rate measurement by the BER meter.A command/query for selecting the range for the error rate measurement by the BER meter.

RANGs

s	Control	Command format
1.00E+02	100	RANG1.00E+02
2.50E+03	2,500	RANG2.50E+03
1.00E+04	10,000	RANG1.00E+04
1.60E+04	16,000	RANG1.60E+04
1.00E+05	100,000	RANG1.00E+05
1.00E+06	1,000,000	RANG1.00E+06

RANG ? ➡ {1.00E+02 | 2.50E+03 | 1.00E+04 | 1.60E+04 | 1.00E+05 | 1.00E+06}

■ Sync command SYNC (Synchronous)

A command/query for selecting the BER meter synchronization mode.

SYNCs

s	Setting	Command format
AUT	Auto	SYNCAUT
NOR	Normal	SYNCNOR

SYNC ? ➡ {AUT | NOR}

■ BER data command BERD (Bit Error Rate Data)

A command/query for selecting the polarity of the BER meter input data.

BERDs

s	Control	Command format
NOR	Normal	BERDNOR
INV	Inverse	BERDINV

BERD ? ➡ {NOR | INV}

■ BER clock command BERC (Bit ERror Clock polarity)

A command/query for selecting the polarity of the BER meter input clock.

BERCs

s	Setting	Command format
POS	Positive	BERCPOS
NEG	Negative	BERCNEG

BERC ? ➡ {POS | NEG}

■ Compare command COMP (COPMare)

A command/query for selecting whether to use the BER meter judgment function.

COMPs

s	Control	Command format
ON	On	COMPON
OF	Off	COMPOF

COMP ? ➡ {ON | OF}

■ Upper command UPPER (UPPER rate)

A command/query for setting the error rate upper limit for the BER meter judgment function.

The parameter must be in the floating-point format.

UPPERr

r	Value	Command format (example)
	0.00E−06 ≦ r ≦ 9.99E−06	UPPER0.00E−00

UPPER ? ➡ d.ddE−0d

Note: UPPER value ≧ LOWER value

■ Lower command LOWER (LOWER rate)

A command/query for setting the error rate lower limit for the BER meter judgment function.

The parameter must be in the floating-point format.

LOWER r

r	Value	Command format (example)
	0.00E−06 ≦ r ≦ 9.99E−06	LOWER0.00E−00

LOWER ? ➡ d.ddE−0d

Note: UPPER value ≧ LOWER value

■ BERM status query STS (read berm STatuS)

A query for reading the BER meter status.

STS ? ➡ {* | n}

*: BER meter unused

n: Decimal status data of BER meter

n = 2^0: Under synchronization

2^1: Synchronization established

2^2: Under measurement

2^3: NOGO result

2^4: Measurement completed

2^5: Time-out

2^6: Communication error (system error)

2^7: Busy (system error)

'*' indicates an unmeasured state. Once the result is read, KSG3500A remains in this state until the next measurement is completed.

■ Rate query RATE (error RATE)

A query for reading the BER meter error rate.

RATE ? ➡ {* | d.ddE−d}

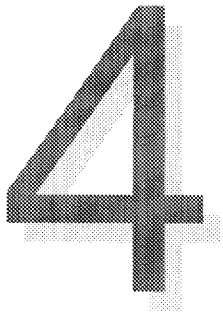
*' indicates an unmeasured state. Once the result is read, KSG3500A remains in this state until the next measurement is completed.

■ Judgment query JUDG (JUDGement)

A query for reading the BER meter judgment result.

JUDG ? ➡ {* | PASS | FAIL}

'*' indicates an unmeasured state. Once the result is read, KSG3500A remains in this state until the next measurement is completed.



Chapter 4
Name and Function of Controls

This chapter describes the name and function of the switches, indicators, and connectors on the front and rear panels of the KSG3500A.

4.1 Front Panel

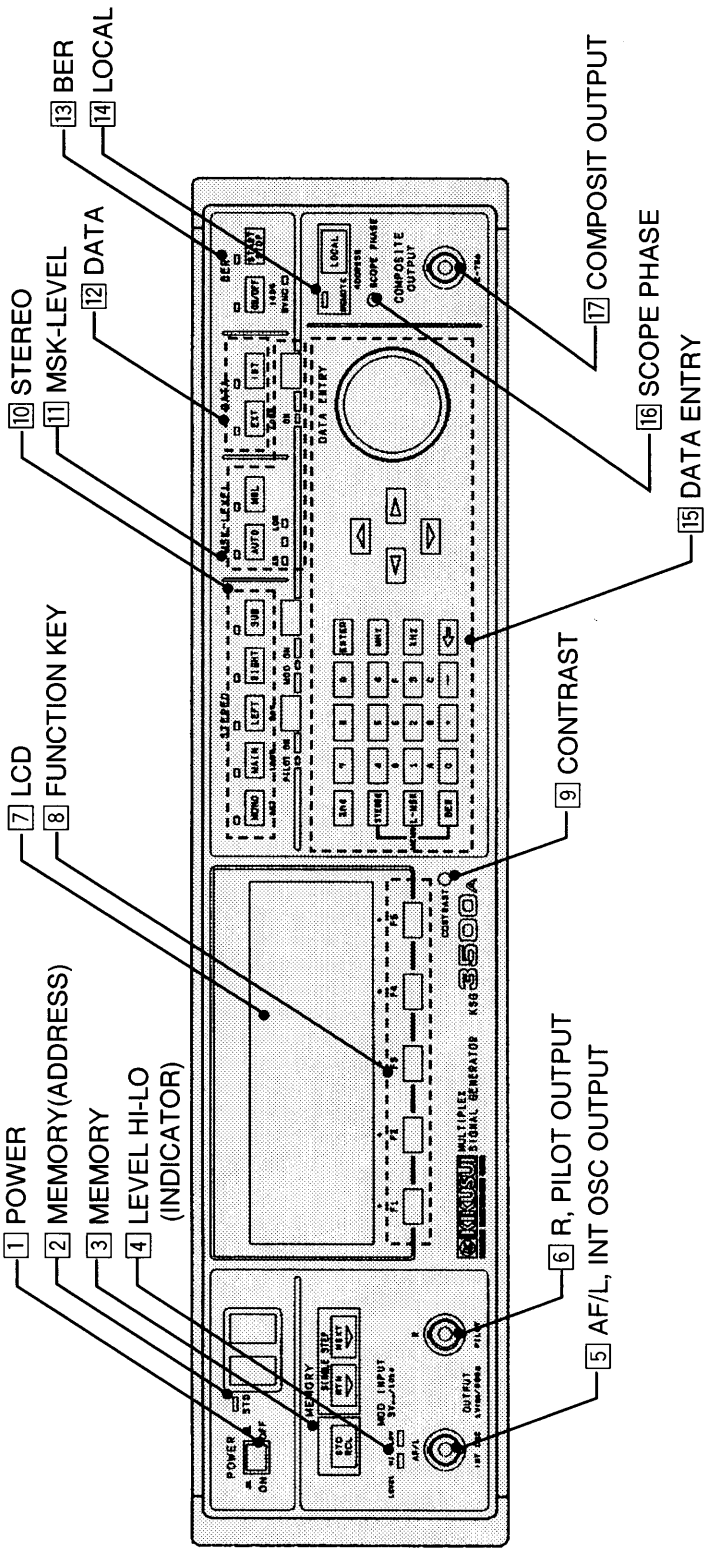


Fig.4-1 Front Panel

[1] POWER switch

This switch is used to turn on or off the power of the KSG3500A. Press this switch to turn on the power and press it again to turn off the power.

When the power is turned on, all indicator on the panel go on and then the condition existed before the power is turned off resumes, except for the [LEVEL HI/LO] indicator.

[2] MEMORY indicator

Displays the row and column numbers of memory address which is allocated in matrix format. The left indicator displays the row number and the right indicator the column number.

Data can be stored in continuous 100 points (00 to 99) of memory or ten blocks each of which consists of 10 points of memory. Each LCD screen and panel key setting, except for the [LEVEL HI/LO] indicator, can be stored in memory.

[3] MEMORY key

- The single-step 【▽(RTN)】 and 【△(NEXT)】 keys can be used to specify the column number of memory address.
- Press the 【▽(RTN)】 key to return to the previous step and press the 【△(NEXT)】 key to proceed with the next step.
- Pressing the 【RCL(STO)】 key and numeric keypad recalls the first row of each block.
- Pressing the 【RCL(STO)】 and 【 · 】 keys clears the row and column display and entering a 2-digit number from the numeric keypad recalls the specified row and column.
- Pressing the 【RCL(STO)】 and 【−】 keys clears the column display and entering a 1-digit number from the numeric keypad recalls the specified column.
- Pressing the 【2nd】 and 【RCL(STO)】 keys and entering a 1-digit number from the numeric keypad allow data to be stored in the first row of the specified block.
- Pressing the 【2nd】 , 【RCL(STO)】 , and 【△(NEXT)】 keys allows the panel settings to be stored in the menu address next to the one currently displayed.
- Pressing the 【2nd】 , 【RCL(STO)】 , and 【 · 】 keys clears the row and column display and entering a 2-digit number from the numeric keypad allows data to be stored in the specified row and column.
- Pressing the 【2nd】 , 【RCL(STO)】 , and 【−】 keys clears the column display and entering a 1-digit number from the numeric keypad allows data to be stored in the specified column.

[4] LEVEL HI/LO indicator

Checks the appropriate input level (approx.3 Vp-p) of the external modulation signal connected to the AF/L connector ([5]).

If the level of the external modulation signal source is too low, the [LO] indicator goes on; if it is too high, the [HI] indicator goes on.

[5] AF/L connector/INT OSC OUTPUT (1Vrms/600Ω)

This connector can be used for the following three purposes:

1. External modulation signal input connector (AF)

   When [source] of the <STEREO> screen is set to EXT, this connector functions as an input connector for modulation with a single external modulation signal.

2. External stereo modulation signal input connector

   When [source] of the <STEREO> screen is set to EXT L/R, this connector functions as a left side stereo modulation signal input connector for modulation with two external modulation signals. (For the right side, this connector functions as the R connector.)

3. Internal signal oscillator output connector

   When [source] of the <STEREO> screen is set to [30Hz], [100Hz], [400Hz], [1kHz], [6.3kHz], [10kHz] or [15kHz], this connector functions as an internal signal oscillator output connector, allowing the KSG3500A to be used as a spot oscillator or synchronization signal source with low distortion.

[6] R connector/PILOT OUTPUT (1Vrms/600Ω)

This connector can be used for the following two purposes:

1. External stereo modulation signal input connector

   When [source] of the <STEREO> screen is set to [EXT L/R], this connector functions as a right side stereo modulation signal input connector for modulation with two external modulation signals. (For the left side, this connector functions as the [AF/L] connector.)

   To check the R side level, connect the signal to the [AF/L] connector and then set the appropriate level using the [LEVEL HI/LO] indicator.

2. Stereo phase monitoring pilot signal output connector

   When [source] of the <STEREO> screen is set to other than [EXT L/R], this connector outputs a stereo phase monitoring pilot signal with 1 Vrms output level and 600-ohm impedance.

[7] LCD (Liquid crystal display) indication

Indicates the monaural/stereo signal modulation level, pilot level, FM multiple signal modulation/output level, BER measurement result, etc.

[8] Function keys (F1 to F5)

Used to move the cursor in the LCD screen and to switch between screens.

[9] CONTRAST

Used to adjust the contrast of the LCD screen.

[10] STEREO

1. 【MONO】, 【MAIN】, 【LEFT】, 【RIGHT】, and 【SUB】 keys
   Used to switch the modulation mode. The mode corresponding to the lit indicator is on.
2. 【PILOT ON】 key
   Used to turn on or off the pilot signal. When the indicator is on, the pilot signal is turned on.
3. 【 MOD ON】 key
   Used to turn on or off monaural/stereo modulation. When the indicator is on, monaural/stereo modulation is turned on.
4. 【2nd】 and 【MONO(SET)】 keys
   Sets the following operation mode:
   Monaural modulation level : 100%
   Pilot level : off
   Internal modulation signal : 1 kHz
   Output level : 3 Vp-p
5. 【2nd】 and 【MAIN(100%)】 keys
   Sets the following operation mode:
   Monaural modulation level : 90%
   Pilot level : 10%
6. 【2nd】 and 【LEFT(30%)】 keys
   Sets the following operation mode:
   Monaural modulation level : 27%
   Pilot level : 10%

[11] MSK-LEVEL

1. 【AUTO】 key
   Used to set the automatic level control on. The automatic level control is on when the indicator LED is lit.
   When it is on, the L-MSK multiple level is automatically controlled to be 4-10%, following the L-R voice modulation level 2.5-5.0% which is the rated value.

2. 【MNL】 key

Used to set the manual level control on. The manual level control is on when the indicator LED is lit.

When it is on, the L-MSK level can be set in the range of 0-20% in the minimum steps of 0.1%. In this case, the L-MSK indicator is fixed at the center value regardless of the L-R voice modulation level.

3. Indicator LEDs

There are three indicator LEDs: less than 4%, 4% to less than 10%, and 10%. The indicator can be used to check the operation state.

4. ON key

Used to set on/off the FM multiple signal (76 kHz carrier suppression MSK signal). The FM multiple signal is on when the indicator is lit.

[12] DATA

1. 【EXT】 key

While the indicator LED is lit, multiple data can be received through the SDI connector on the rear panel.

The data is sent from the personal computer through RS-232C.

2. 【INT】 key

While the indicator LED is lit, multiple data is set in PN9 which is a built-in pseudo random signal.

3. 【2nd】 and 【EXT (100%)】 keys

The following conditions are set:

Stereo modulation	: 85%
Pilot level	: 10%
MSK modulation level control	: ON

[13] BER

1. 【ON/OFF】 key

Used to set the BER on/off. The BER is on when the indicator LED is lit. When on, the LCD indicator indicates the BER measurement result area. When off, this area is erased from the LCD indicator.

2. 【START/STOP】 key

Used to start/stop the BER measurement function. It is valid when the BER ON/OFF key is ON. The BER measurement function is on when the indicator LED is lit.

3. [SYNC] indicator LED (synchronization indicator)

When this LED is lit, the synchronous matching measurement is enabled.

When this LED is not lit, synchronous measurement is being prepared, synchronization is disabled, or measurement is being suspended.

14 LOCAL

1. 【LOCAL】 key

   In the remote control mode (【REMOTE】 indicator goes on), the panel control resumes by pressing the 【LOCAL】 key. However, the key does not operate in the local lockout condition.

2. [REMOTE] indicator

   Goes on in the remote control mode and goes off in the local mode.

3. 【2nd 】 and 【LOCAL】 keys

   Pressing the 【2nd】 and 【LOCAL】 keys displays the <REMOTE Setup> screen, allowing GPIB and RS-232C settings to be made.

15 DATA ENTRY

1. 【2nd】 key

   Press the 【2nd 】 key and then any key with a yellow indication executes the corresponding function.

2. 【STEREO】 , 【L-MSK】 , and 【BER】 keys

   Used to switch the LCD to the <STEREO>, <L-MSK main>, or <BER main> screen.

3. Numeric keypad

   Used to enter numbers 0 to 9 and symbols "." and "-".

4. 【ENTER】 key

   Used as a terminator for data entry. The terminator is not necessary at the time of MEMORY setting and setting with the rotary knob.

5. 【⇦】 key

   The BS (backspace) key is used to modify numeric data during entry. This key can also be used to update the screen.

6. 【△】 , 【▽】 , 【◁】 , and 【▷】 keys

   Used to move the cursor in the LCD screen.

7. Rotary knob

   Used to change the cursor position setting.

16 SCOPE PHASE

Used to make fine adjustment of the phase of the oscilloscope which monitors the phase of 32 kHz sub-carrier and pilot signal.

17 COMPOSITE OUTPUT (Z=75Ω)

This BNC connector is used as an output connector for the composite signal consisting of the stereo signal, L-MSK signal.

Since the output impedance is approx. 75 Ω, the signal can be supplied to standard FM signal generators and transmitters with high or low input impedance. The output level ranges from 1.5 Vp-p to 10 Vp-p.

4.2 Rear Panel

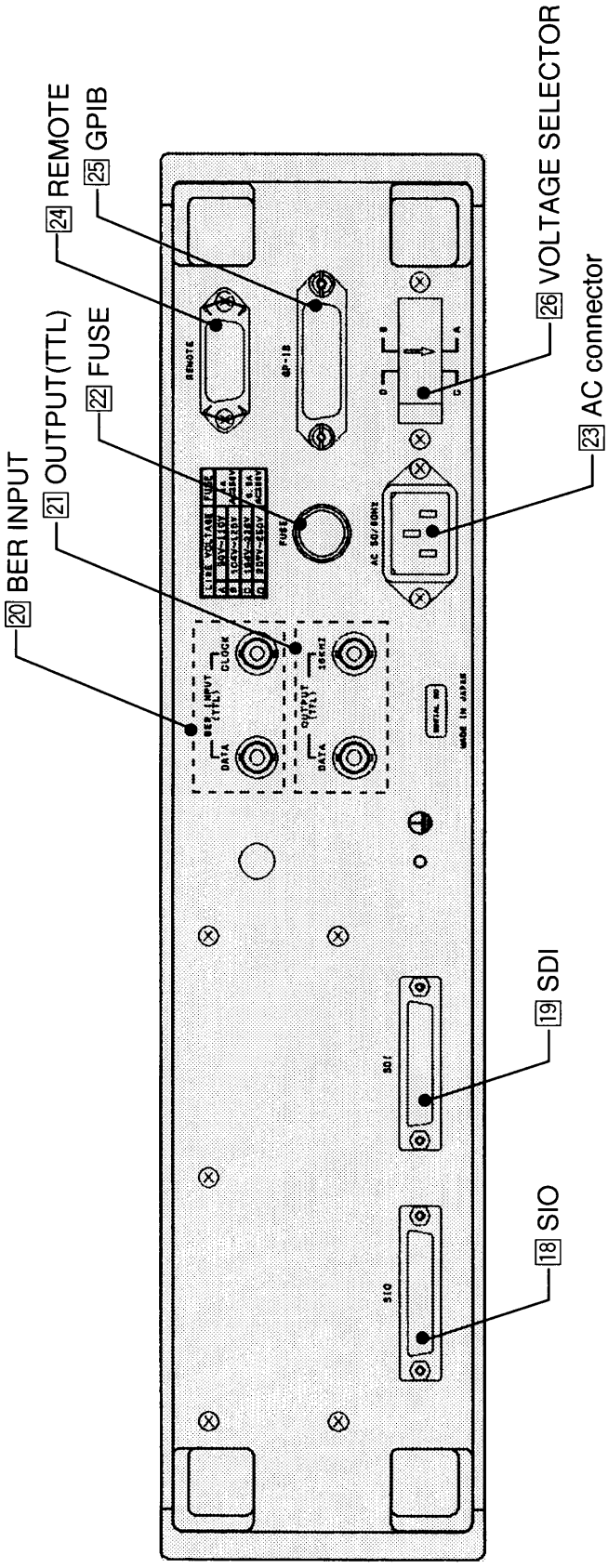


Fig.4-2 Rear Panel

18 SIO connector

Used to control the KSG3500A by means of the serial interface (RS-232C).

19 SDI connector

FM multiple data input connector (RS-232C level).

20 BER INPUT connectors

1. DATA connector

   A measurement input connector for the bit error rate meter. It is used to measure the PN9 data error rate.

   The input level is TTL. This connector is always used together with the BER INPUT CLOCK connector.

2. CLOCK connector

   A clock input connector for synchronization during bit error rate measurement.

   The input level is TTL.

21 OUTPUT (TTL) connector

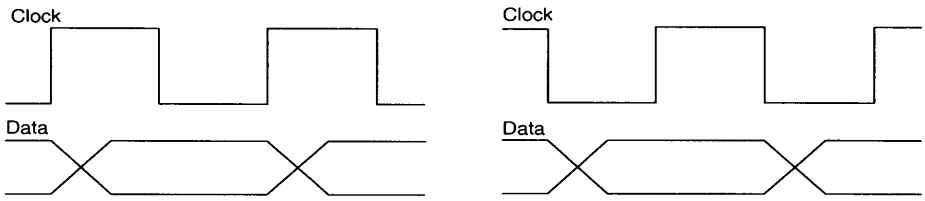
1. DATA connector of L-MSK

   A connector for outputting FM multiple signal (data) in TTL.

2. 16 kHz connector

   A connector for outputting the data synchronization clock for the FM multiple signal in TTL.

   The following chart shows the timings of the FM multiple signal data and synchronizing clock.



(a) For Ck-pol+ (b) For ck-pol-

22 FUSE

Used for the input power fuse.

Use a fuse which conforms to the input power voltage. Specifications of applicable fuses are inscribed on the LINE VOLTAGE table on the rear panel.

23 50/60 Hz AC connector

Used to connect the input power cable.

24 REMOTE connector

Used for remote control of panel operation.

25 GPIB connector

Used for GPIB control.

26 VOLTAGE SELECTOR

Used select the power voltage. Set this selector so that the arrow on the plug points to the voltage used.

27 ⏚

Protective ground terminal

Chapter 5
Maintenance and Calibration

To ensure a long operating life, perform maintenance, inspection, and calibration periodically.

5.1 Cleaning

If the panel is dirty, clean it with a soft cloth dampened with mild detergent dissolved in water.

CAUTION

- Be sure to disconnect the power cable from the receptacle before starting cleaning.
- Do not use volatile substances such as thinner or benzene. Otherwise, the panel surface may become discolored, printed letters erased, or the LCD may turn whitish.

5.2 Checking

Check that there is no scratch on the coating of the AC power cable and that the power plug is not dislocated or cracked.

WARNING

- Scratch on the coating of the AC power cable may cause electrical shock. Stop using it immediately.

For purchase of accessories, contact your Kikusui agent.

5.3 Calibration

Calibrating Pilot Phase

Prepare an oscilloscope with the X-Y function.
Prior to calibration or adjustment, warm up the KSG3500A for 30 minutes or more.

① Connect the KSG3500A and the oscilloscope as shown in Fig.5-1.

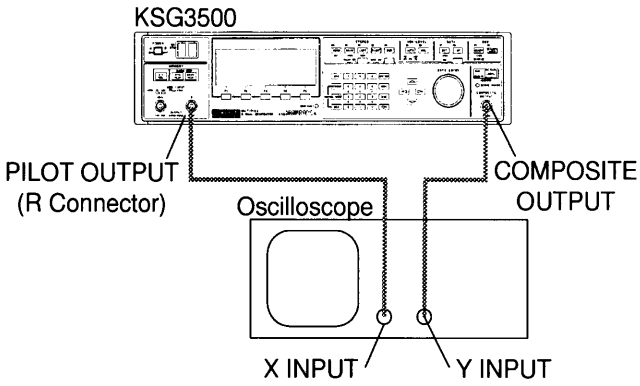


Fig.5-1 Oscilloscope Connection

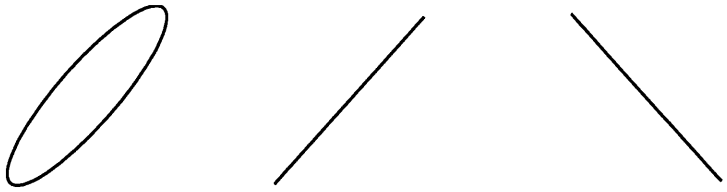
② Press the 【2nd】 and 【MONO(SET)】 keys.
(The output level is set to 3.00 Vp-p, monaural modulation level to 100%, and internal modulation signal to 1 kHz.)

③ Press the 【2nd】 and 【MAIN(100%)】 keys.
(The stereo modulation level is set to 90% and pilot level to 10%.)

④ Press the 【STEREO】 key to display the <STEREO> screen.
⑤ Press the STEREO 【MOD ON】 key to turn off the [MOD ON] key indicator and stereo modulation.

⑥ Set the input sensitivity of the oscilloscope (X INPUT to 0.2 V/DIV and Y INPUT to 0.1 V/DIV).

Make sure that the oscilloscope displays the waveform shown in Fig.5-2(b). If the waveform is out of phase, adjust it by turning the SCOPE PHASE.



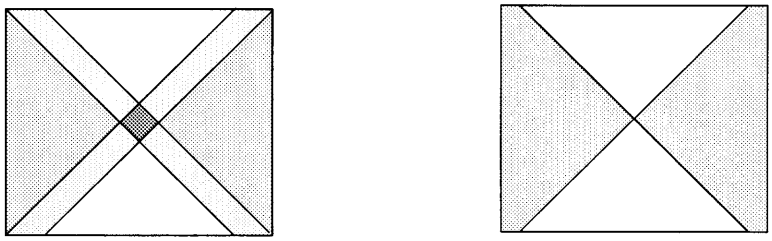
(a) Out of phase (b) In phase (c) Out of phase 180°

Fig.5-2 Pilot Phase Calibration

⑦ Make the following settings of the KSG3500A.

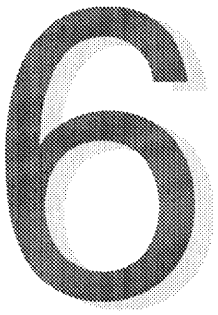
- Turn off the 【PILOT ON】 key. (The [PILOT ON] indicator goes off.)
- Press the STEREO 【SUB】 key. (The [SUB] indicator goes on.)

Make sure that the oscilloscope displays the waveform shown in Fig.5-3(b). If it displays the waveform shown in Fig.5-3(a), the waveform is still out of phase. Make adjustment in ⑥ again.



(a) Out of phase (b) In phase

Fig.5-3 Pilot Phase Checking



Chapter 6 Specifications

This chapter explains electrical and mechanical specifications and accessories.

6.1 Specifications

6.1 Specifications

1) FM multiple data, PN9 signal

Item	Description
Sub-carrier wave frequency/ accuracy	76kHz ±0.01%
Modulation range	Data " 0 " : 76kHz−4kHz Data " 1 " : 76kHz+4kHz
Multiple level control	ON/OFF ON: 4-10% set automatically, rated value (L-R voice modulation factor 2.5 to 5.0%) OFF: 0-20% set manually Set resolution 0.1%
Transmission bit rate/accuracy	16kbps ±0.01%
Switching function	1. Level-follower function ON/OFF (L-MSK) 2. Multiple output ON/OFF 3. Switching between generated data (external), built-in pseudo random signal PN9, and IntData 4. Starting PN9 signal transmission can be initialized. 5. BER measurement function ON/OFF Display function
Display function	1. Multiple-level operation indicator 3-point display: <4%, 4-10%, and >10% 2. Setting and displaying output, modulation, and multiple levels
Panel setting	Set with numeric keypad or rotary knob
EXT synchronizing clock output	RS-232C level (rear panel)
EXT data input	RS-232C level (rear panel)
Data output	TTL (rear panel), FAN OUT 1
16 kHz clock output	TTL (rear panel), FAN OUT 1
Internal memory	60 frames Output by 10 frames in a unit (USER1-3, USER5-7) Output 30 frames (USER4) Output 60 frames (USER8)

2) Bit error rate (BER) measurement

Item	Description
Measurement pattern	PN9 signal
Measurement bit range	1.00E+02, 2.50E+03 1.00E+03, 1.60E+04 1.00E+05, 1.00E+06
Measurement display	0.00E00 to 1.00E00
Measurement input	TTL (rear panel), FAN IN 1
Measurement input polarity (phase)	Non-inverse or inverse selected
16 kHz clock input	TTL (rear panel), FAN IN 1
Clock input polarity (phase)	Non-inverse or inverse selected
PN9 initialization	PN9 initialized when switching between EXT and PN9 or starting BER measurement

3) Stereo/monaural signal

Item	Description
Frequency characteristics	Stereo : ±0.3dB 30Hz to 15kHz 1 kHz reference Monaural : ±0.5dB 30Hz to 80kHz 1 kHz reference
Modulation range	Stereo: 0 to 100% Monaural: 0 to 100% Resolution: 0.5% Accuracy: (Indicated value ±5)%
Distortion ratio	At modulation band width 30 Hz to 15 kHz ≦0.01% 200 Hz to 10 kHz ≦0.05% 30 Hz to 15 kHz
S/N	At modulation band width 30 Hz to 15 kHz ≧86dB
Separation	≧66dB 30 Hz to 15 kHz
Composite output range	1.5 Vp-p to 10 Vp-p Open-end voltage Resolution: 10 mVp-p Accuracy: (Indicated value ±5)% Impedance: Approximately 75Ω, unbalanced
Pilot signal	Frequency and accuracy: 19 kHz, ±1 Hz Modulation range: 0 to 15 %, 10% rated level Resolution: 1% Accuracy: (Indicated value ±2)%
Pre-emphasis	off、25 μs、50 μs、75 μs
Internal modulation signal	Frequency and accuracy : 30Hz、100Hz、400Hz、1kHz 6.3kHz、10kHz、15kHz ±5%
External modulation signal input	a)AF/L Frequency range Stereo : 30Hz to 15kHz Monaural : 30Hz to 80kHz Input voltage : ±2% width HI-LO for 3 Vp-p input voltage, with a monitor Input impedance : Approximately 10 kΩ, unbalanced b)R Frequency range Stereo : 30Hz to 15kHz Input voltage : ±2% width HI-LO for 3 Vp-p input voltage (checked by connecting to AF/L), with a monitor Input impedance : Approximately 10 kΩ, unbalanced
Internal modulation signal output	Frequency: Conforming to internal modulator frequency Output voltage: Approximately 1 Vrms, open-end voltage Impedance: Approximately 600Ω, unbalanced Distortion ratio: ≦0.01% at demodulation band width 30 Hz to 15 kHz
Pilot output	Voltage: Approximately 1 Vrms, open-end voltage Impedance: Approximately 600 Ω, unbalanced
Display function	Menu screens selected with MENU and F1 to F5 keys; setting and display of modulation level, output level, functions, etc.

4) GPIB interface

Function	Type	Description
Transmit handshake	SH1	Function provided
Reception handshake	AH1	Function provided
Talker	T6	Function provided
Listener	L4	Basic listener function only
Service request	SR1	Function provided
Remote/local	RL1	Function provided
Parallel Poll	PP0	Function not provided
Device clear	DC1	Function provided
Device trigger	DT0	Function not provided
Controller	C0	Function not provided

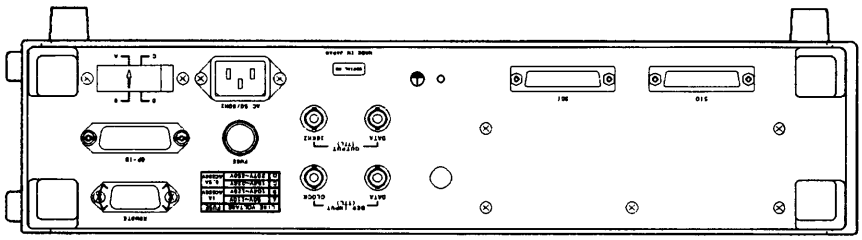
5) SIO interface

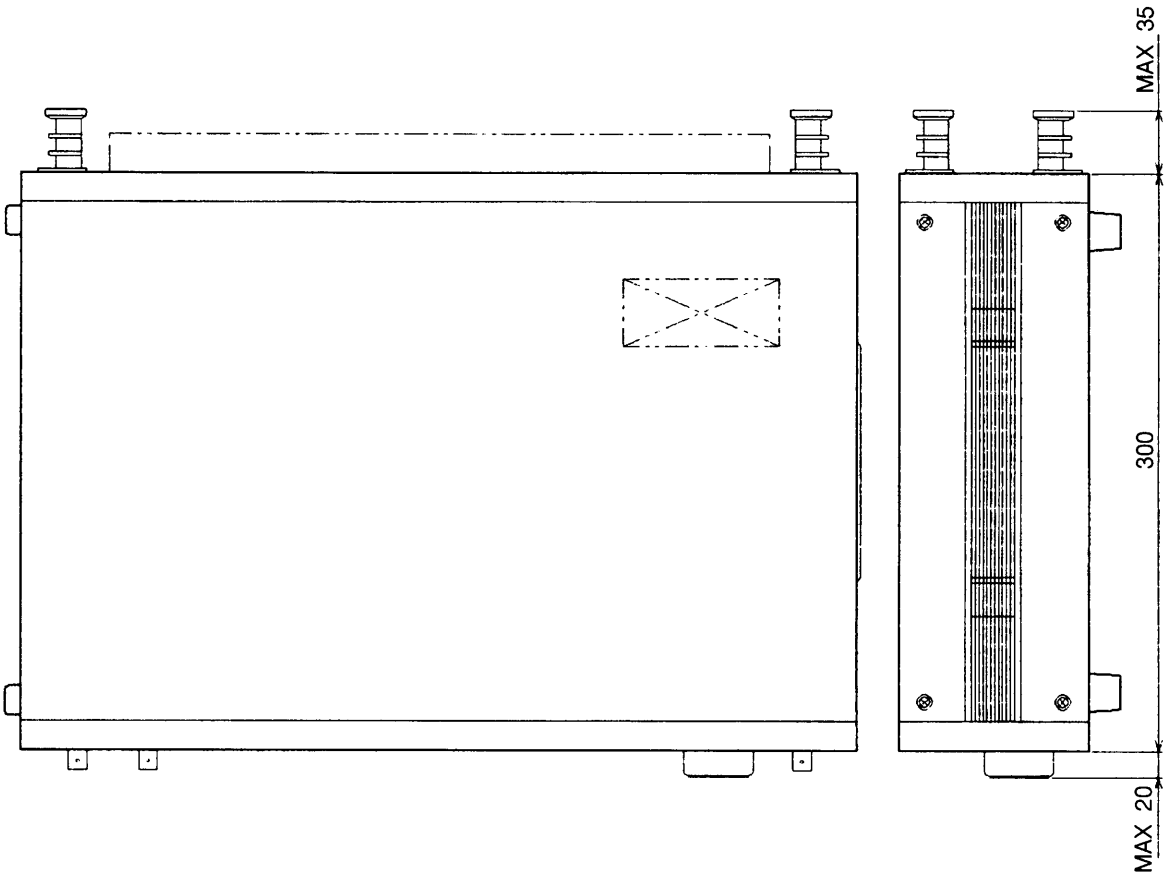
Item	Description
Baud rate	300bps、600bps、1200bps、2400bps, 4800bps、9600bps
Data bit length	7 or 8 bits
Stop bit length	1 or 2 bits
Parity check	Even, odd, or no parity
Others	Asynchronous
Backup battery	Lithium battery lasting 3 or more years (from shipment) at 25℃

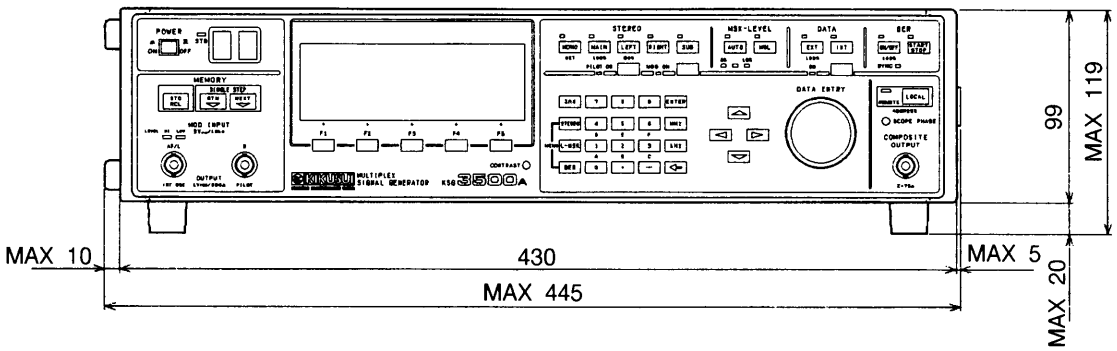
6) Others

Item		Description
Mode setting	Monaural/stereo signal	MONO, MAIN, LEFT, RIGHT, SUB
	Modulation	MOD ON/OFF
	Pilot signal	PILOT ON/OFF
	FM multiple data/PN9	EXT DATA, INT
Function setting	Numeric keypad, rotary knob	Setting monaural/stereo modulation level, pilot level,output level, L-MSK modulation level, memory, etc.
	Preset keys	Monaural: 100% (output level setting) Stereo: 100%, 30% L-MSK multiple level: 4 to 10%
Memory function		1) Available up to 10 points x 10 or 100 successive points 2) Store (with store indicator) 3) Recall 4) Memory address increase/decrease 5) Memory address return
Remote control		Equivalent to operations on front panel
Input power	Available voltage range	100 V, 115 V, 215 V, or 230 V±10% (selected by rear panel switch) Maximum voltage: 250 V
	Frequency	50/60 Hz
	Power consumption	Approximately 33 VA
Body	Outside dimensions	400 (W) x 99 (H) x 250 (D) mm (frame) 445 (W) x 119 (H) x 305 (D) mm (maximum)
	Weight	Approximately 7 kg
Environmental conditions	Operating conditions by specifications	5 to 35℃ ≦85%RH
	Maximum allowable conditions	0 to 40℃ ≦90%RH
Accessories	Output cable (SA750)	One
	Power cable	One
	Operation manual	One
	Fuse, 1.0 A	One
	Fuse, 0.5 A	One

7) External Dimensions







Unit: mm

Appendices

These programs control KSG3500A through the GPIB and RS-232C using BASIC language for NEC PC9801. At the end of BER measurement, they read the error rate and judgment results by an SRQ interrupt. The program in Appendix 3 transfers FM multiple data to KSG3500A through the GPIB interface.

Appendix 1 Sample GPIB program <KSG3500G.BAS>

This sample program measures the bit error rate by controlling KSG3500A through the GPIB interface. The end of measurement is detected by SRQ.

100-140 : Comment lines

150 : Sets the waiting time between issuing the KSG3500A GPIB address and query command and reading the read-back data and also sets the loop count.

160-230 : Table of GPIB commands for controlling KSG3500A.

240 : Prepares the computer for remote control of KSG3500A.

250 : Declares starting the SRQ interrupt processing routine upon detection of SRQ.

270-400 : Clears the status register and errors, transmits commands listed in the GPIB command table, sets the modulation type, output level, BER meter, etc., enables SRQ, and then enters a loop waiting for SRQ. The program checks the end flag; if it is set, control jumps to the end processing.

420-520 : An interrupt processing routine called when SRQ occurs. It reads the status, error rate, and judgment result after serial polling. The program checks the loop counter; if it shows the end, the program sets the end flag.

540-620 : Stops SRQ as the end processing and transmit the end command listed in the GPIB command table. Control returns to the beginning of the infinite loop.

640-710 : Processing routine for transmitting a GPIB command to KSG3500A. After transmitting a command, it checks whether the command has been processed normally.

730-780 : Processing routine for clearing the KSG3500A error status.

800-850 : Processing routine which issues a query command to KSG3500A, awaits the read-back waiting time, and then reads data from KSG3500A.

```
100 'save "b:\ksg3500g.bas",a
110 '== The sample program for ksg3500 GPIB I/F ===
120 '       25 Jan. '94          Kikusui Electronics Corp.
130 ' Note: set up speed before executing this program.
140 '
150 KSG = 10 : DELAY.FOR.READBACK = 1000 : LOOP.COUNT = 10
160 CMD.SRQE$    = "Srqena"
170 CMD.STEREO$ ="Smodmain;Modon;Mod10.0pc;Plon;Pl10pc;Pre75us;Src6.3khz"
180 CMD.MSK$     = "Sdidnor;Sdicpos;Phase0.5pc;Lev20.0pc;Out10.00vp-p"
190 CMD.BER1$    = "Dataext;Rangl.00e+04;Syncnor"
200 CMD.BER2$    = "Compon;Upperl.00e-03;Lower6.50e-06"
210 CMD.RUN$     = "Mskon;Bermon;Berstr"
220 CMD.SRQD$    = "Srqdis"
230 CMD.END$     = "Berstp;Bermof;Mskof"
240 ISET IFC : ISET REN : CMD DELIM=0 : SRQ OFF
250 ON SRQ GOSUB *SRQ.ON
260 '
270 *BEGIN
280 POLL KSG,DUMY
290 GOSUB *CLEAR.ERROR.STATUS
300 COMMAND$ = CMD.SRQE$    : GOSUB *SEND.COMMAND.TO.KSG
310 COMMAND$ = CMD.STEREO$ : GOSUB *SEND.COMMAND.TO.KSG
320 COMMAND$ = CMD.MSK$     : GOSUB *SEND.COMMAND.TO.KSG
330 COMMAND$ = CMD.BER1$    : GOSUB *SEND.COMMAND.TO.KSG
340 COMMAND$ = CMD.BER2$    : GOSUB *SEND.COMMAND.TO.KSG
350 COMMAND$ = CMD.RUN$     : GOSUB *SEND.COMMAND.TO.KSG
360 NCOUNT = 0 : END.THEN = 0
```

```
370 SRQ ON
380 *WAITTING.FOR.SRQ
390  IF END.THEN = 1 THEN GOTO *END.THEN.NEXT
400 GOTO *WAITTING.FOR.SRQ
410 '
420 '  <end berm measurement.>
430 *SRQ.ON
440 POLL KSG,STB
450 NCOUNT = NCOUNT+1
460 QUERY$="Sts?"  : GOSUB *READ.RXDATA.FROM.KSG : STS$ =RXDATA$
470 QUERY$="Rate?" : GOSUB *READ.RXDATA.FROM.KSG : RATE$=RXDATA$
480 QUERY$="Judg?" : GOSUB *READ.RXDATA.FROM.KSG : JUDG$=RXDATA$
490 PRINT NCOUNT,
500 PRINT "  STB?= ";STB;"  STS?= ";STS$;"  RATE?= ";RATE$;"  JUDG?= ";JUDG$
510 IF NCOUNT >= LOOP.COUNT  THEN END.THEN = 1
520 SRQ ON : RETURN
530 '
540 *END.THEN.NEXT
550 '  <stop ber meter.>
560 SRQ OFF
570 COMMAND$ = CMD.SRQD$     : GOSUB *SEND.COMMAND.TO.KSG
580 COMMAND$ = CMD.END$      : GOSUB *SEND.COMMAND.TO.KSG
590 PRINT "### Completed  ###" : PRINT
600 FOR W=0 TO 3000 : NEXT W
610 GOTO *BEGIN
620 END
630 '
640 '  << send the command to KSG3500. >>
650 *SEND.COMMAND.TO.KSG
660 PRINT @KSG;COMMAND$@        ' with EOI
670 QUERY$ = "Err?": GOSUB *READ.RXDATA.FROM.KSG
680 IF RXDATA$ = "0" THEN RETURN
690 BEEP : PRINT "# occured command error!! #"
700 PRINT "command= "+COMMAND$
710 END
720 '
730 '  << clear error status. >>
740 *CLEAR.ERROR.STATUS
750 FOR WAIT.FOR.NOERROR = 0 TO 4
760    QUERY$ = "Err?": GOSUB *READ.RXDATA.FROM.KSG
770 NEXT WAIT.FOR.NOERROR
780 RETURN
790 '
800 '  << read data from KSG3500. >>
810 *READ.RXDATA.FROM.KSG
820 PRINT @KSG;QUERY$@          ' with EOI
830 FOR WAIT.A.MINUTE=0 TO DELAY.FOR.READBACK : NEXT WAIT.A.MINUTE
840 LINE INPUT @KSG;RXDATA$
850 RETURN
```

Appendix 2 Sample SIO Program <KSG3500R.BAS>

This sample program measures the bit error rate by controlling KSG3500A through the RS-232C interface. The end of measurement is detected by polling the status register.

100-120 : Comment lines

130-140 : Sets the waiting time between issuing the query command and reading the read-back data, the loop count, and the handshake characters for RS-232C communication.

150-220 : Table of commands for controlling KSG3500A.

230 : Sets communication parameters for RS-232C.

250-490 : Clears the status register and errors, transmits commands listed in the command table, sets the modulation type, output level, BER meter, etc., and then enters the loop for polling the status register. If the measurement has been completed, it reads the error rate and judgment results. It checks the loop counter; if it shows the end, the program transmits the end command listed in the command table. Control returns to the beginning of the infinite loop.

510-580 : Processing routine for transmitting a command to KSG3500A. After transmitting a command, it checks whether the command has been processed normally.

590-640 : Processing routine which issues a query command to KSG3500A, awaits the read-back waiting time, and then reads data from KSG3500A.

```
100 'save "b:\KSG3500R,BAS",A
110 '== This is a sample program for ksg3500 RS-232C I/F ===
120 '           25 Jan. '94      Kikusui Electronics Corp.
130 DELAY.FOR.READBACK = 2500  : LOOP.COUNT = 10
140 ACK$ = CHR$(6) : NL$=CHR$(13)+CHR$(10)
150 CMD.REMOTE$ = "Rem"
160 CMD.STEREO$ = "Smodmain;Mod50.0%;Pl10%;Preof;Src15khz"
170 CMD.LMSK$   = "Sdidnor;Sdicpos;Phase0.0%;Lev10.0%;Out5.00vp-p"
180 CMD.BER1$   = "Datapn9;Rang2.50e+03;Syncaut"
190 CMD.BER2$   = "Compon;Upper1.00e-03;Lower6.50e-06"
200 CMD.GO$     = "Mskon;Bermon;Berstr"
210 CMD.END$    = "Mskof;Berstp;Bermof"
220 CMD.LOCAL$  = "Loc"
230 OPEN "COM:N81NN" AS #1
240 '
250 *BEGIN
260 GOSUB *CLEAR.ERROR.STATUS
270 COMMAND$ = CMD.REMOTE$ : GOSUB *SEND.COMMAND.TO.KSG
280 COMMAND$ = CMD.STEREO$ : GOSUB *SEND.COMMAND.TO.KSG
290 COMMAND$ = CMD.LMSK$   : GOSUB *SEND.COMMAND.TO.KSG
300 COMMAND$ = CMD.BER1$   : GOSUB *SEND.COMMAND.TO.KSG
310 COMMAND$ = CMD.BER2$   : GOSUB *SEND.COMMAND.TO.KSG
320 PRINT #1,CMD.GO$
330 NCOUNT = 0
340 *WATCH.STATUS
350    QUERY$="Sts?" : GOSUB *READ.RXDATA.FROM.KSG : STS$=RXDATA$
360 IF STS$ = "*" THEN GOTO *WATCH.STATUS
```

```
370 '  <end berm measurement.>
380 NCOUNT = NCOUNT+1
390 QUERY$="Rate?" : GOSUB *READ.RXDATA.FROM.KSG : RATE$=RXDATA$
400 QUERY$="Judg?" : GOSUB *READ.RXDATA.FROM.KSG : JUDG$=RXDATA$
410 PRINT NCOUNT,"STS? = ";STS$,"RATE?= ";RATE$,"JUDG?= ";JUDG$
420 IF NCOUNT < LOOP.COUNT THEN GOTO *WATCH.STATUS
430 '  <stop ber meter.>
440 PRINT #1,CMD.END$
450 COMMAND$ = CMD.LOCAL$  : GOSUB *SEND.COMMAND.TO.KSG
460 PRINT "### Completed  ###" : PRINT
470 FOR W=0 TO 3000 : NEXT W
480 GOTO *BEGIN
490 END
510 '  << send the command to KSG3500. >>
520 *SEND.COMMAND.TO.KSG
530 PRINT #1,COMMAND$
540 QUERY$ = "Err?": GOSUB *READ.RXDATA.FROM.KSG
550 IF RXDATA$ = "0" THEN RETURN
560 BEEP : PRINT "# occured command error!! #"
570 PRINT "command= "+COMMAND$
580 END
590 '  << read data from KSG3500. >>
600 *READ.RXDATA.FROM.KSG
610 PRINT #1,QUERY$
620 FOR WAIT.A.MINUTE=0 TO DELAY.FOR.READBACK : NEXT WAIT.A.MINUTE
630 PRINT #1,ACK$ : LINE INPUT #1,RXDATA$
640 RETURN
650 '  << clear error status. >>
660 *CLEAR.ERROR.STATUS
670 FOR WAIT.ERROR.0 = 0 TO 4
680    QUERY$ = "Err?": GOSUB *READ.RXDATA.FROM.KSG
690 NEXT WAIT.ERROR.0
700 RETURN
```

Appendix 3 Sample GPIB Data Transfer Program <KSG3500T.BAS>

This sample program makes a binary transfer of FM multiple data to KSG3500A through the GPIB interface. It transfers a frame of binary files DATA1.FRB, DATA2.FRB, and DATA3.FRB ten times successively to the KSG3500A's USER1, USER2, and USER3, respectively.

100-130 : Comment lines
140 : Reserves a buffer for reading a binary file of one frame.
150 : Sets the KSG3500A GPIB address and the parameters for binary load and binary transfer.
160 : Sets the loop, frame, and byte counters.
170-220 : A table of GPIB commands for controlling KSG3500A.
230 : Prepares the computer for remote control of KSG3500A.
250-340 : Sequentially sets USER1, USER2, and USER3 as the transfer destinations of KSG3500A. Approximately 0.1 second will be awaited until the binary transfer is ready.
350-360 : Prepares for binary loading.
370-430 : Sequentially loads binary files DATA1.FRB, DATA2.FRB, and DATA3.FRB by individual frames.
440 : Specifies the controller (computer) as the talker and KSG3500A as the listener for binary transfer to KSG3500A.
450-470 : Makes binary transfer of 1-frame data to KSG3500A.
480 : Repeats from line 370 until the frame counter indicates 10.
490 : Issues a transfer end command when transfer of ten frames has completed.
500 : Repeats from line 260 until transfer of three files has completed.
510-530 : Clears the remote mode at the end of processing.

```
100 'save "b:\KSG3500T,BAS",A
110 '== The sample program for ksg3500 GPIB Data Transfer ===
120 '           12 May. '95  Kikusui Electronics Corp.
130 '
140 DIM AIBLOCK%(10000)
150 KSG = 10 : SEGADR%=1 : PTDSEG%=0
160 LOOP.COUNT = 0 : TEN.FRM = 10 : FRM.COUNT = 0 : BIN.COUNT = 9792
170 SIG.WRT.NAME1$ ="SIGWRTUSER1"
180 SIG.WRT.NAME2$ ="SIGWRTUSER2"
190 SIG.WRT.NAME3$ ="SIGWRTUSER3"
200 DATA1.NAME$ ="DATA1.FRB"
210 DATA2.NAME$ ="DATA2.FRB"
220 DATA3.NAME$ ="DATA3.FRB"
230 ISET IFC : ISET REN
240 '
250 *BEGIN
260 FOR LOOP.COUNT = 1 TO 3
270   IF LOOP.COUNT = 1 THEN PRINT @KSG; SIG.WRT.NAME1$
280   ELSE
290   IF LOOP.COUNT = 2 THEN PRINT @KSG; SIG.WRT.NAME2$
300   ELSE
310   IF LOOP.COUNT = 3 THEN PRINT @KSG;SIG.WRT.NAME3$
320   ELSE PRINT "ERR":PRINT "  ":GOTO *ENDDING
```

```
330   FOR CNT% = 1 TO 1000 STEP 1     'DELAY TIME
340   NEXT CNT%
350   PTDSEG%=VARPTR(AIBLOCK%(10000),SEGADR%)
360   DEF SEG=PTDSEG%
370   FOR FRM.COUNT = 1 TO TEN.FRM STEP 1
380     IF LOOP.COUNT = 1 THEN BLOAD DATA1.NAME$,PTDSEG%
390     ELSE
400     IF LOOP.COUNT = 2 THEN BLOAD DATA2.NAME$,PTDSEG%
410     ELSE
420     IF LOOP.COUNT = 3 THEN BLOAD DATA3.NAME$, PTDSEG%
430     ELSE PRINT "ERR":GOTO *ENDDING
440       WBYTE 64+0,32+KSG;
450     FOR CNT% = 0 TO BIN.COUNT-1 STEP 1
460       WBYTE;    PEEK(CNT%+PTDSEG%)
470     NEXT CNT%
480   NEXT FRM.COUNT
490   PRINT @KSG;"SIGEND"
500 NEXT LOOP.COUNT
510 IRESET REN
520 '
530 *ENDDING
540 END
```

Appendix 4 Binary Format

In order to synchronize the receiver to the FM multiple signal generated by KSG3500A, a binary signal file based on the FM multiple ratings (see note) must be sent to KSG3500A.

A file format is described below, using data containing only one packet.

List 1 is a part of 1-frame binary data file containing one packet, where the broadcasting station identification for the local segment in the additional information is set as follows: the extended country identification code = 1, the country identification code = 2, the cover area code = 3, the network identification code = 4, and the additional number in covered area = 5.

As for actual 1-packet data except the check bits, BIC1 = C87A, prefix = 2D00, segment size = 3, data = 01, 23, 85 through CRC = 7E69. The other part up to the 9792th byte contains the block identification, prefix, data block 00, and parity packets.

To make the signal given in list 1 to that conforming to the FM multiple signal ratings, horizontal/vertical parity calculations, scrambling, and interleave processing are necessary.

List 2 shows a part of a 1-frame binary data obtained by the above processing on the data file given in List 1.

A signal conforming to the FM multiple signal ratings can be generated by transferring binary data of successive ten frames to KSG3500A in the similar format as List 2.

Note: FM multiple signal ratings are based on:

Official gazette (Extra Edition No. 164) 25 August, 1994

Notification No. 461 of Ministry of Post and Telecommunications

========== List 1 ==========

```
Address
00000000  C8 7A 2D 00 13 01 23 85-00 00 00 00 00 00 00 00
00000010  00 00 00 00 00 00 7E 69-00 00 00 00 00 00 00 00
00000020  00 00 00 00 C8 7A 2F 01-01 00 00 00 00 00 00 00
00000030  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00
00000040  00 00 00 00 00 00 00 00-C8 7A 2F 01 01 00 00 00
00000050  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00
00000060  00 00 00 00 00 00 00 00-00 00 00 00 C8 7A 2F 01
    .
    .
000025F0  00 00 00 00 00 00 00 00-13 AE 00 00 00 00 00 00
00002600  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00
00002610  00 00 00 00 00 00 00 00-00 00 00 00 13 AE 00 00
00002620  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00
00002630  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00
```

========== List 2 ==========

```
Address
00000000  C8 7A D8 55 92 53 6C F2-E0 5C F2 BA 22 61 0E BD
00000010  CD C2 3D FC 07 EF DD 5A-3C 58 A1 65 EB CD 58 0E
00000020  2A AB 7A ED C8 7A DA 54-80 52 4F 77 E0 5C F2 BA
00000030  22 61 0E BD CD C2 3D FC-07 EF A3 33 37 F0 DB 63
00000040  81 31 2C B4 15 C4 6D 80-C8 7A DA 54 80 52 4F 77
00000050  E0 5C F2 BA 22 61 0E BD-CD C2 3D FC 07 EF A3 33
00000060  37 F0 DB 63 81 31 2C B4-15 C4 6D 80 C8 7A DA 54
    .
    .
000025F0  81 31 2C B4 15 C4 6D 80-E5 89 DA 54 80 52 4F 77
00002600  E0 5C F2 BA 22 61 0E BD-CD C2 3D FC 07 EF A3 33
00002610  37 F0 DB 63 81 31 2C B4-15 C4 6D 80 13 AE F5 55
00002620  81 52 4F 77 E0 5C F2 BA-22 61 0E BD CD C2 3D FC
00002630  07 EF A3 33 41 CA 2D 9E-CF 46 25 8E AD 8E 8C 08
```

Appendix 5 Program Code List

Command header	Query	Description	RS-232C only	GPIB only	Page
BER	BER?	Command/query for starting/stopping the BER meter.		○	3-23
BERC	BERC?	Command/query for selecting the polarity of BER meter input clock.			3-25
BERD	BERD?	Command/query for selecting the polarity of BER meter input data.			3-24
BERM	BERM?	Command/query for controlling the BER meter.			3-23
COMP	COMP?	Command/query for selecting whether to use the BER meter judgment function.			3-25
DATA	DATA?	Command/query for selecting data for L-MSK modulation.			3-21
DCL		Command for initializing KSG3500A.	○		3-18
	ERR?	Query for reading syntactic judgment results for commands already input.			3-18
GTL		Command for changing KSG to local state from local lock-out state.	○		3-18
	IDN?	Query for reading the KSG3500A model name and ROM version.			3-18
	JUDG?	Query for reading the BER meter judgment results.			3-27
LEV	LEV?	Command/query for setting the L-MSK modulation level.			3-21
LLO		Command for setting KSG3500A in local out state.	○		3-17
LOC		Command for setting KSG3500A in local state.	○		3-17
LOWER	LOWER?	Command/query for setting the error rate lower limit value for the BER meter judgment function.			3-26
MOD	MOD?	Command/query for controlling/setting the modulation level.			3-19
	MEM?	Query for reading the number of the currently called memory.			3-17
MSK	MSK?	Command/query for setting the L-MSK modulation on/off.			3-20
OUT	OUT?	Command/query for setting the output level.			3-21
PL	PL?	Command/query for controlling/setting the pilot level.			3-19
PLAN	PLAN?	Command/query for changing the menu screen.			3-15
PRE	PRE?	Command/query for controlling/setting the pre-emphasis.			3-20
RANG	RANG?	Command/query for selecting the error rate measurement range of the BER meter.			3-24
	RATE?	Query for reading the BER meter error rate.			3-26
RC		Command for recalling all settings from memory.			3-16
REM		Command for setting KSG3500A in remote state.	○		3-17
SDIC	SDIC?	Command/query for selecting the polarity of L-MSK modulation external clock.			3-22
SDID	SDID?	Command/query for selecting the polarity of L-MSK modulation external data.			3-22
SMOD	SMOD?	Command/query for controlling stereo mode.			3-19
SRC	SRC?	Command/query for selecting the modulation source.			3-20
SRQ	SRQ?	Command/query for enabling/disabling the GPIB interface service request function.		○	3-16
ST		Command for storing all settings in memory.			3-17
	STS?	Query for reading the BER meter status.			3-26
SYNC	SYNC?	Command/query for selecting the BER meter synchronization mode.			3-24
UPPER	UPPER?	Command/query for setting the error rate upper limit for the BER meter judgment function.			3-25
SIGWRT		Command for informing the internal memory that signal data will be transferred.		○	3-22
SIGEND		Command for informing the internal memory that signal data transfer has ended.		○	3-23

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